# REGISTER

OF

# LEHIGH UNIVERSITY

1923-1924

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BETHLEHEM
PENNSYLVANIA

PUBLISHED BY THE UNIVERSITY
May, 1924

# 1923

## JULY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## AUGUST

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## SEPTEMBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | ... | ... | ... | ... | ... | ... |

## OCTOBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## NOVEMBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## DECEMBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | ... | ... | ... | ... | ... |

# 1924

## JANUARY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## FEBRUARY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | .. | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MARCH

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | ... | ... | ... | ... | ... |

## APRIL

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MAY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| ... | ... | ... | ... | ... | ... | ... |

## JUNE

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## JULY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## AUGUST

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## SEPTEMBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## OCTOBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## NOVEMBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | ... | ... | ... | ... | ... | ... |

## DECEMBER

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

# 1925

## JANUARY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| .. | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| ... | ... | ... | ... | ... | ... | ... |

## FEBRUARY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| ... | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MARCH

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## APRIL

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MAY

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## JUNE

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

# UNIVERSITY CALENDAR

## 1923-1924

*1923*

Sept. 14, 15, 17, 18 (Friday, Saturday, Monday, Tuesday) ..... Examinations for admission
**Sept. 19, 3.30 p.m. (Wednesday) ..... First term begins**
Oct. 6 (Saturday) ..... Founder's Day
Nov. 28, 4.00 p.m. (Wednesday) ..... Thanksgiving holidays begin
Dec. 3, 7.45 a.m. (Monday) ..... Thanksgiving holidays end
Dec. 19, 4.00 p.m. (Wednesday) ..... Christmas holidays begin

*1924*

Jan. 3, 7.45 a.m. (Thursday) ..... Christmas holidays end
Jan. 28, 8.00 a.m. (Monday) ..... Examinations begin
**Feb. 2, 5.00 p.m. (Saturday) ..... Examinations end**
**Feb. 7, 7.45 a.m. (Thursday) ..... Second term begins**
Feb. 22 (Friday, Washington's Birthday) .. Junior Oratorical Contest
April 16, 4.00 p.m. (Wednesday) ..... Easter holidays begin
April 21, 7.45 a.m. (Monday) ..... Easter holidays end
May 26, 8.00 a.m. (Monday) ..... Examinations begin
**May 31, 5.00 p.m. (Saturday) ..... Examinations end**
June 7 (Saturday) ..... Alumni Day
June 8 (Sunday) ..... Baccalaureate Sunday
June 9 (Monday) ..... Class Day
**June 10 (Tuesday) ..... University Day**
June 11 (Wednesday) ..... Summer session begins
June 11, 12, 13, 14 (Wednesday, Thursday, Friday, Saturday) ..... Examinations for admission

## 1924-1925

*1924*

Sept. 12, 13, 15, 16 (Friday, Saturday, Monday, Tuesday) ..... Examinations for admission
Sept. 15, 16, 17 (Monday, Tuesday, Wednesday) ..... Registration days
**Sept. 17, 3.30 p.m. (Wednesday) ..... First term begins**
Oct. 4 (Saturday) ..... Founder's Day
Nov. 26, 4.00 p.m. (Wednesday) ..... Thanksgiving holidays begin
Dec. 1, 8.00 a.m. (Monday) ..... Thanksgiving holidays end
Dec. 20, 12.00 m. (Saturday) ..... Christmas holidays begin

*1925*

Jan. 5, 8.00 a.m. (Monday) ..... Christmas holidays end
Jan. 26, 8.00 a.m. (Monday) ..... Examinations begin
**Jan. 31, 5.00 p.m. (Saturday) ..... Examinations end**
Feb. 3, 4 (Tuesday, Wednesday) ..... Registration days
**Feb. 5, 8.00 a.m. (Thursday) ..... Second term begins**
Feb. 23 (Monday) ..... Junior Oratorical Contest
April 8, 4.00 p.m. (Wednesday) ..... Easter holidays begin
April 13, 8.00 a.m. (Monday) ..... Easter holidays end
May 25, 8.00 a.m. (Monday) ..... Examinations begin
**May 30, 5.00 p.m. (Saturday) ..... Examinations end**
June 6 (Saturday) ..... Alumni Day
June 7 (Sunday) ..... Baccalaureate Sunday
June 8 (Monday) ..... Class Day
**June 9 (Tuesday) ..... University Day**
June 10 (Wednesday) ..... Summer session begins
June 10, 11, 12, 13 (Wednesday, Thursday, Friday, Saturday) ..... Examinations for admission

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**ASSISTANTS**

JUDSON GRAY SMULL, B.S., M.S.
*Assistant in Chemistry*

MARCUS CABRIN OLD, B.A.
*Assistant in Biology*

SERGEANT JONATHAN MADDEN
*Assistant in Military Science and Tactics*

SERGEANT THOMAS JOSEPH LAVIN
*Assistant in Military Science and Tactics*

SERGEANT JAMES ROBERT BOYLE
*Assistant in Military Science and Tactics*

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WALTER E. HESS, B.A., LL.B.
*Lecturer in the Evening School of Business Administration*

PAUL S. OLSEN, B.A., M.A.
*Lecturer in the Evening School of Business Administration*

## COMMITTEES OF THE FACULTY

*Admissions:* DEAN McCONN, PROFESSORS HUGHES, THORNBURG, PALMER, FOX, THAYER, BABASINIAN, REYNOLDS.

*Athletics:* PROFESSORS REITER, ECKFELDT, PATCH

*Discipline:* DEAN McCONN, PROFESSORS BABASINIAN, LUCH, OGBURN; PROFESSOR LARKIN, *Alternate*

*Educational Policy:* PRESIDENT RICHARDS, PROFESSORS MILLER, LAMBERT, PALMER, THORNBURG, FOGG.

*Extension Courses:* PROFESSORS HUGHES, SCHEALER, LUCH, CHAPMAN, BICKLEY, MacNUTT

*Graduate Courses:* PROFESSORS THAYER, FOX, MORE, BABASINIAN, E. KLEIN

*Honorary Degrees:* PRESIDENT RICHARDS, PROFESSORS ULLMANN, STOUGHTON, ECKFELDT, ESTY, MILLER, BUTTERFIELD

*Petitions:* DEAN McCONN, PROFESSORS CHAPMAN, SEYFERT

*Standing of Students:* DEAN McCONN, PROFESSORS PALMER, CAROTHERS, ULLMANN, FOGG, ESTY, LARKIN, STOUGHTON, ECKFELDT, CHAPMAN, MacNUTT

*Student Activities:* DEAN McCONN, PROFESSORS SCHEALER, ECKFELDT, FRAIM, LARKIN, DIEFENDERFER

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## ADMINISTRATIVE OFFICERS

PRESIDENT OF THE UNIVERSITY

CHARLES RUSS RICHARDS, M.M.E., ENG.D., LL.D.

VICE-PRESIDENT AND COMPTROLLER

NATT MORRILL EMERY, M.A., LITT.D.

DEAN

CHARLES MAXWELL McCONN, A.M.

## HEADS OF CURRICULA

PHILIP MASON PALMER, A.B., *Head of the College of Arts and Science*

JOHN LAMMEY STEWART, A.B., PH.B., *Head of the College of Business Administration*
(On leave of absence from December 1, 1923)

NEIL CAROTHERS, PH.D., *Acting Head of the College of Business Administration* (from December 1, 1923)

RALPH JUSTIN FOGG, B.S., *Head of the Curriculum in Civil Engineering*

FRED VIALL LARKIN, B.S., M.E., *Head of the Curriculum in Mechanical Engineering*

BRADLEY STOUGHTON, PH.B., B.S., *Head of the Curriculum in Metallurgy*

HOWARD ECKFELDT, B.S., E.M., *Head of the Curriculum in Mining Engineering*

WILLIAM ESTY, S.B., M.A., *Head of the Curriculum in Electrical Engineering*

HARRY MASS ULLMAN, PH.D., *Head of the Curricula in Chemistry and Chemical Engineering*

LAWRENCE BOYLSTON CHAPMAN, S.B., *Head of the Curriculum in Marine Engineering and Transportation*

BARRY MACNUTT, E.E., M.S., *Head of the Curriculum in Engineering Physics*

## OTHER OFFICERS

REV. D. WILMOT GATESON, A.B., *Chaplain*

RAYMOND COOLEY BULL, B.S., A.B., M.D., *Director of Students' Health Service*

FREDERICK RALPH ASHBAUGH, *Bursar and Purchasing Agent*

THOMAS EDGAR SHIELDS, A.A.G.O., *Organist and Director of the Band*

J. CLARENCE CRANMER, *Superintendent of Buildings and Grounds*

PETER F. STAUFFER, *Assistant Librarian*

CLARENCE HENRY BOEHM, *Assistant Treasurer* (resigned)

ENGLEBERT HENRY BADERSCHNEIDER, *Manager of Supply Bureau*

Mrs. ORA INGLE HICKEY, B.S., *Recorder*

DOWNA PETERS WILLS, R.N., *Nurse in Charge of Dispensary*

JOHN D. HARTIGAN, *Master Mechanic*

PAUL ROESTEL, *Steward of University Commons*

# LEHIGH UNIVERSITY

## GENERAL STATEMENT

Lehigh University was chartered by the Legislature of Pennsylvania by an act dated February 9, 1866. In 1865 the Hon. Asa Packer, of Mauch Chunk, inaugurated a movement to provide an institution that would afford training and education in the learned professions as then recognized, and in technical branches, the importance of which was then just becoming apparent in the development of the industrial and transportation interests of the country. He made an initial donation of $500,000 and of a large tract of land for this purpose, to which he added largely during his lifetime and by his will.

Since its foundation the equipment and resources of the University have steadily increased due to the continued interest of the University's trustees, alumni, and friends. The present endowment totals $3,000,000. The first important addition to the University's original plant was the Sayre Observatory, donated in 1869 by Robert H. Sayre, of Bethlehem. Later donations include Packer Memorial Church, 1887; Williams Hall, 1902; Drown Memorial Hall, 1907; the University Commons, 1907; the Wilbur Heating Plant and Engineering Laboratory, 1907; Taylor Hall, 1907; Sayre Park, 1909; the Coxe Mining Laboratory, 1910; the Fritz Engineering Laboratory, 1910; Taylor Gymnasium and Taylor Field, 1913.

Lehigh University offers the following curricula:

College of Arts and Science:

- The Curriculum in Arts and Science
- The Pre-Medical Curriculum

College of Business Administration:

- The Curriculum in Business Administration

College of Engineering:

- The Curriculum in Civil Engineering
- The Curriculum in Mechanical Engineering
- The Curriculum in Metallurgy

The Curriculum in Mining Engineering
The Curriculum in Electrical Engineering
The Curriculum in Chemistry
The Curriculum in Chemical Engineering
The Curriculum in Marine Engineering and Transportation
The Curriculum in Engineering Physics

These curricula are described in detail on pages 28 to 77.

## REQUIREMENTS FOR ADMISSION

Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in fifteen entrance units* as enumerated below. The regular undergraduate curricula are open to men only.

### THE COLLEGE OF ARTS AND SCIENCE

Candidates for admission to the College of Arts and Science must present the following subjects:

| | Units* |
|---|---|
| English, | 3 |
| History, | 1 |
| Elementary Algebra, A and B, | 1½ |
| Plane Geometry, | 1 |
| Latin A and B, or German A, or French A, or Spanish A, | 2 |
| Elective subjects | 6½ |
| | 15 |

### THE COLLEGE OF BUSINESS ADMINISTRATION

Candidates for admission to the College of Business Administration must present the following subjects:

| | Units* |
|---|---|
| English, | 3 |
| History, | 1 |
| Elementary Algebra, A and B, | 1½ |
| Plane Geometry, | 1 |
| German A, or French A, or Spanish A, or Latin A and B, | 2 |
| Elective subjects | 6½ |
| | 15 |

*A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work. A four-year secondary school curriculum should be regarded as representing not more than sixteen units of work.

## THE COLLEGE OF ENGINEERING

Candidates for admission to the College of Engineering must present the following subjects:

| | Units* |
|---|---|
| English, | 3 |
| History, | 1 |
| Elementary Algebra, A and B, | 1½ |
| Plane Geometry, | 1 |
| Solid Geometry, | ½ |
| Plane Trigonometry and Logarithms, | ½ |
| German A, or French A, or Spanish A, or Latin A and B, | 2 |
| Elective subjects, | 5½ |
| | 15 |

## ELECTIVE SUBJECTS

| | Units |
|---|---|
| Advanced Algebra, | ½ |
| Solid Geometry, | ½ |
| Plane Trigonometry and Logarithms, | ½ |
| Greek, | 1, 2, or 3 |
| Latin, | 1, 2, 3, or 4 |
| French, | 1, 2, or 3 |
| German, | 1, 2, or 3 |
| Spanish, | 1, 2, or 3 |
| American History, | 1 |
| Ancient History, | ½ or 1 |
| Modern History, | 1 |
| English History, | ½ or 1 |
| Civics, | ½, 1, or 1½ |
| Economics, | ½ or 1 |
| General Science, | 1 |
| Physics, | 1 |
| Chemistry | 1 |
| Biology, | ½ or 1 |
| Physiology and Hygiene, | ½ or 1 |
| Physiography, | ½ or 1 |
| Manual Training, | ½ or 1 |
| Freehand Drawing, | ½ |
| Mechanical Drawing, | ½ |
| Industrial History, | ½ or 1 |
| Commercial Geography, | ½ or 1 |
| Bookkeeping, Stenography, and Typewriting, | 1 or 2 |

Other subjects from the curriculum of a high school of the first class may be credited up to a total of one unit.

Detailed information concerning these subjects is given on pages 22 to 27.

## ADMISSION BY CERTIFICATE

Lehigh University has no permanent arrangement with any school whereby certificates are accepted in place of entrance examinations; but certificates are ordinarily accepted from First-Class High Schools in Pennsylvania, and from schools accredited by the New England College Entrance Certificate Board, the Regents of the University of the State of New York, the North Central Association of Colleges and Secondary Schools, the Association of Colleges and Secondary Schools of the Southern States, and the state universities of those states which have such institutions.

An applicant for admission by certificate should request his school principal to send to the Dean, as soon as the school closes in June, a complete record of his work. Blanks for this purpose will be supplied by the University.

## ADMISSION BY EXAMINATION

*Examinations at the University*

Examinations for admission to the University are held in June and September in the following order:

*First Day.*—Geometry, 8 a.m.; Physics, Ancient History, 2 p.m.

*Second Day.*—Elementary Algebra, *A,* 8 a.m. to 10 a.m., Elementary Algebra, *B,* 10 a.m. to 12 m.; Trigonometry, 2 p.m.

*Third Day.*—Latin, 8 a.m.; German, French, Spanish, Greek, 2 p.m.

*Fourth Day.*—English, 8.30 a.m.; History, 2 p.m.

The dates for 1924 and 1925 are as follows: in 1924, June 11, 12, 13, and 14, and September 12, 13, 15, and 16; in 1925, June 10, 11, 12, and 13, and September 18, 19, 21, and 22.

Examinations in subjects presented for elective units may be arranged for by correspondence with the Dean.

Candidates for admission wishing to take examinations for advanced credit in any subject should notify the Dean before September 1.

*Examinations at Schools*

Upon the request of school principals the June entrance examinations may be held at schools on the regularly scheduled dates. Requests for examination papers should be sent to the Dean before June 1.

*College Board and Regents' Examinations*

Certificates of the College Entrance Examination Board and of the Regents of the University of the State of New York are accepted in subjects in which the recorded grade is 60 per cent. or higher.

The examinations of the College Entrance Examination Board are held in June of each year. Information in regard to these examinations, application blanks, and a circular giving detailed definitions of requirements in all examination subjects may be obtained by addressing the Secretary of the College Entrance Examination Board, 431 West 117th Street, New York, N. Y. The price of the circular is twenty cents; it may be remitted in stamps.

## ADMISSION TO ADVANCED STANDING

A student desiring to transfer to Lehigh from another college or university should submit an official transcript of his record in the other institution, which should include, with his college credits, a memorandum of the entrance credits accepted for admission to that other institution and a notation of honorable dismissal.

Graduates of other colleges may be admitted without examinations to the engineering courses of Lehigh University. The length of time for the completion of a course will depend upon the student's attainments at entrance and his ability. Every opportunity is given for the completion of a course in minimum time.

A student who anticipates taking a technical course at Lehigh University after graduation from college should so arrange his work in college as to cover as many as possible of the subjects of the freshman and sophomore years of the technical course he intends to enter.

## ADMISSION TO GRADUATE COURSES

For admission to graduate courses see page 130.

## ENTRANCE REQUIREMENTS IN DETAIL BY SUBJECTS

### ENGLISH

Preparation in English has three main objects: (a) command of correct and clear English, spoken and written; (b) ability to use the vernacular with accuracy and appreciation; and (c) some acquaintance with the simpler English classics.

English Grammar and Composition. The first two objects require instruction in grammar and composition. English grammar should be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition based upon the principles of elementary rhetoric, as given in any approved high school rhetoric. It is advisable that subjects for this work be taken from the students' personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be supported by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written, making every recitation in some degree an exercise in English.

Literature. The third object is sought by means of two lists of books, headed respectively reading and study, from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose. The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English *3 units*

## HISTORY

The requirement in history is based on the recommendations of the Committee of Seven of the American Historical Association.

Ancient History, with special reference to Greek and Roman History, including also a short introductory study of the more ancient nations, and the chief events of the early Middle Ages down to the death of Charlemagne (814). *1 unit*

Mediaeval and Modern European History, from the death of Charlemagne to the present time. *1 unit*

English History, with due reference to social and political development. *1 unit*

American History and Civil Government, with due reference to social and political development. *1 unit*

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map.

## MATHEMATICS

Elementary Algebra, A (Algebra to Quadratics). The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. *1 unit*

ELEMENTARY ALGEBRA, B (QUADRATICS AND BEYOND). Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the *nth* term and the sum of the terms of arithmetic and geometric progressions with applications.

*½ unit*

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descartes' rule of sign and Horner's method, but not Sturm's functions or multiple roots.

*½ unit*

PLANE GEOMETRY. The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons; and the measurements of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of line and plane surfaces. *1 unit*

SOLID GEOMETRY. The usual theorems and constructions of good textbooks, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Application to the mensuration of surfaces and solids. *½ unit*

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. *½ unit*

Candidates must have a knowledge of the metric system and be prepared to solve problems in either algebra or geometry involving the use of the metric system.

## GREEK

GREEK. Grammar; elementary prose composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical construction; Xenophon: the first four books of the *Anabasis;* the translation, at sight, of a passage from some work of Xenophon. *2 units*

GREEK. Homer's *Iliad,* I-III: The first three books of the *Iliad* (omitting II, 494-end), and the Homeric forms, constructions, and prosody. *1 unit*

## LATIN

The following requirements in Latin are in accordance with the recommendations made by the American Philological Association, October, 1909.

LATIN, A and B. First and Second Year Latin. Grammar, elementary prose composition. Reading of an amount not less than Cæsar, *Gallic War,* I-V, selected by the schools from Cæsar (*Gallic War* and *Civil War*) and Nepos (*Lives*). *2 units*

LATIN, C. Third Year Latin. Reading of an amount not less than Cicero, *Orations against Catiline, For the Manilian Law,* and *For Archias,* selected by the schools from Cicero *(Orations, Letters,* and *De Senectute)* and Sallust *(Catiline* and *Jugurthine War).* *1 unit*

LATIN, D. Fourth Year Latin. Reading of an amount not less than Vergil, *Aeneid,* I-VI, selected by the schools from Vergil *(Aeneid, Bucolics,* and *Georgics)* and Ovid *(Metamorphoses, Fasti, Tristia, Amores).* *1 unit*

## GERMAN

ELEMENTARY GERMAN, A. This requirement follows, in the main, the recommendation of the Committee of Twelve to the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise: (1) Careful drill in pronunciation. (2) The memorizing and frequent repetition of easy colloquial sentences. (3) Drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of everyday life, of adjectives, pronouns, weak verbs, and the more usual strong verbs; also upon the use of the more common prepositions, the simpler use of the modal auxiliaries, and the elementary rules of syntax and word-order. (4) Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression. (5) Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise: (1) The reading of from 150 to 200 pages of literature in the form of easy stories and plays. (2) Accompanying practice, as before, in the translation into German of easy variations upon the matter read and in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages. (3) Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and, secondly, to state his knowledge correctly in the technical language of grammar. *2 units*

INTERMEDIATE GERMAN, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses, and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation. *1 unit*

## FRENCH

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise: (1) Careful drill in pronunciation. (2) The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives, participles, and pronouns; the use of personal pronouns, common adverbs, prepositions, and conjunctions; the order of words in the sentence and the elementary rules of syntax. (3) Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of

natural forms of expression. (4) The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read. (5) Writing French from dictation.

During the second year the work should comprise: (1) The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches. (2) Constant practice, as in the previous year, in translating into French easy variations upon the texts read. (3) Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read. (4) Writing French from dictation. (5) Continued drill upon the rudiments of grammar, with constant application in the construction of sentences. (6) Mastery of the forms and uses of pronouns and pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. *2 units*

Intermediate French, B. This should comprise the reading of from 400 to 600 pages of French, of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. *1 unit*

## SPANISH

Elementary Spanish, A. Two years' preparation, covering the following ground:

During the first year: (1) Drill in the correct production of Spanish sounds. (2) The rudiments of grammar, illustrated by abundant easy exercises. (3) The reading of about 150 pages of graduated texts with constant translating into Spanish of easy variations of sentences read, the teacher giving the English. (4) Aural drill: practice in translating into English Spanish words, clauses, and sentences heard but not seen, the teacher giving the Spanish.

During the second year: (1) Reading of 250 to 400 pages of easy modern prose. (2) Constant practice in translating into Spanish easy variations upon the texts read. (3) Aural practice and drill in pronunciation. (4) Mastery of the forms and uses of pronouns, of the subjunctive mode, and of the forms of the radical changing verbs. *2 units*

Intermediate Spanish, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. *1 unit*

## PHYSICS

The course of instruction in physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject; (b) instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics; (c) individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illustrations of fundamental principles and their practical applications. They should be such as to yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units. *1 unit*

## CHEMISTRY

The requirement in chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) individual laboratory work, comprising at least forty exercises; (b) instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general priciples involved in the pupil's laboratory investigations; (c) the study of at least one standard text-book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. *1 unit*

Students properly qualified will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Elementary Chemistry (390) and will instead take Chemistry (393) and Chemical Laboratory (393a) during the first term.

## ZOOLOGY

ZOOLOGY. The equivalent of Jordan, Kellogg, and Heath's *Animal Studies*, with laboratory work. *½ or 1 unit*

## BOTANY

BOTANY. An amount equal to that contained in Bergen's *Foundations of Botany*, with laboratory work. *½ or 1 unit*

## PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering approximately what is given in such a text-book as Huxley and Youman's *Physiology and Hygiene*. *½ or 1 unit*

## PHYSIOGRAPHY

PHYSIOGRAPHY. The study of a standard text-book in physical geography, that a knowledge may be gained of the essential principles and of well-selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended. *½ or 1 unit*

## DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. *½ unit*

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. *½ unit*

## MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. *½ or 1 unit*

## BOOKKEEPING, TYPEWRITING, AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING, AND STENOGRAPHY, covering a formal course of study in school. *1 or 2 units*

## THE COLLEGE OF ARTS AND SCIENCE

The College of Arts and Science of Lehigh University represents the traditional college curriculum, modified to meet the needs of modern life and thought. Such a curriculum is, in its purpose, primarily informing and cultural, not vocational; it seeks to gratify intellectual curiosity, to cultivate a love of learning, to impart the knowledge and discipline which are essential to intelligent and forceful living. It has besides certain specific uses: it is the customary approach to the professions of medicine, law, theology, and teaching, and the usual basis for graduate study for higher degrees.

The entrance requirements are liberal, and such as may be met readily by graduates of Pennsylvania high schools of the first class. A statement of them may be found on page 19.

The plan of study comprises required subjects and unassigned or elective subjects. The required and elective subjects occupy respectively about two-thirds and one-third of the curriculum. The required studies embrace courses in the English, German, and French languages and literatures (two years each), mathematics (trigonometry and solid geometry), chemistry (elementary chemistry and quantitative analysis), economics, history, psychology, biology, geology, and philosophy, subjects which may be regarded as fundamental to the nature and purpose of the course.

The studies of the freshman year follow in general the subjects which have been presented for entrance. After the freshman year the curriculum becomes increasingly elective, a minimum of three hours weekly of electives being allowed in the sophomore year, six in the junior year, and ten in the senior year. An appointed member of the Faculty counsels students in the choice of their studies and keeps before them the importance of selecting their work according to a definite and constructive plan. Students are dealt with individually rather than in groups, and the effort is made to suit the studies of each to his qualifications and purpose.

The minimum course of study comprises fifteen scholastic hours or periods weekly. Work is assigned on the assumption that two hours are required by the average student to prepare ade-

quately for a recitation. Students of proved ability, however, are not limited to this minimum after the freshman year, and even in that year an entering student may increase his course in chemistry from three to four hours, if, as in the case of those who are preparing for the study of medicine, there is good reason. In general, the College aims at a reasonable amount of work well done, rather than a large amount indifferently done.

Instruction is given by lectures, by recitations, by the assignment of readings and topics for study and dissertations, and, when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in geology, physics, chemistry, biology, psychology, and allied subjects; students in advanced mathematics use, in their study of astronomy, the telescope and other instruments of the Sayre Observatory. Practice in teaching is provided in the schools of the vicinity for those who expect to follow teaching. Students residing in Leonard Hall, who are preparing, under the direction of the Bishop of the Episcopal Diocese of Bethlehem, for the theological seminary, have opportunity for practical religious work.

In the following plan of study the unassigned hours are filled by subjects selected from the listed elective studies. These are not necessarily confined to the year to which in the lists they are assigned, but may be taken earlier or subsequently. But this privilege is limited by considerations of the roster and the principle that the course of each student shall be systematic and not haphazard.

Students who enter with full entrance requirements in Latin and Greek (four or three units) will continue these studies during the freshman year. A class in Beginners' Greek, open to freshmen and sophomores, is formed in alternate years. Students who begin Greek in college will ordinarily pursue the study of Greek for three years.

The degree of Bachelor of Arts (B.A.) is conferred upon graduates of the College of Arts and Science.

# THE CURRICULUM IN ARTS AND SCIENCE

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | 120, 121 | (3) | 3 | 6 | 9 | English | 122, 125 | (3) | 3 | 6 | 9 |
| Plane Trig. | 141 | (3) | 3 | 6 | 9 | Solid Geom. | 140 | (3) | 3 | 6 | 9 |
| German or French | 77 or 70 / 98 | (3) | 3 | 6 | 9 | German or French | 77 or 71 / 99 | (3) | 3 | 6 | 9 |
| Latin or A. & M. Civil. | 45 or 54a / 47 | (3) | 3 | 6 | 9 | Latin or A. & M. Civil. | 46 or 54b / 47 | (3) | 3 | 6 | 9 |
| Greek or Chem.&Lab. or Physics | 55 or 64 / 390,392 / 331 | (3) / (3) / (3) | 3 / 5 / 3 | 6 / 4 / 6 | 9 / 9 / 9 | Greek or Chem. or Physics | 56 or 64 / 395,397 / 331 | (3) / (3) / (3) | 3 / 9 / 3 | 6 / 0 / 6 | 9 / 9 / 9 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 17 | 19 | 32 | 51 | | | 17 | 19 | 32 | 51 |

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | 123 | (3) | 3 | 6 | 9 | English | 124 | (3) | 3 | 6 | 9 |
| Economics | 16 | (3) | 3 | 6 | 9 | Economics | 17 | (3) | 3 | 6 | 9 |
| Latin or Greek or Phys. | 48 / 57 / 331 | (3) | 3 | 6 | 9 | Latin or Greek or Phys. | 49 / 58 / 331 | (3) | 3 | 6 | 9 |
| or Chem. | 390, 392 | (3) | 5 | 4 | 9 | or Chem. | 395, 397 | | 9 | 0 | 9 |
| German or French | 78 or77 / 100 | (3) | 3 | 6 | 9 | German or French | 79 or 77 / 101 | (3) | 3 | 6 | 9 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| Electives | | (3) | 3 | 6 | 9 | Electives | | (3) | 3 | 6 | 9 |
| | | 17 | 19 | 32 | 51 | | | 17 | 19 | 32 | 51 |

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Psychology | 1 | (3) | 3 | 6 | 9 | Psychology | 2 | (3) | 3 | 6 | 9 |
| French or German | 90 / 70 | (3) | 3 | 6 | 9 | French or German | 90 / 71 | (3) | 3 | 6 | 9 |
| Biology | 292 | (3) | 5 | 4 | 9 | Gen. Geology | 268 | (2) | 2 | 3 | 5 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Geol. Lab. | 269 | (1) | 2 | 2 | 4 |
| Electives | | (6) | 6 | 12 | 18 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | | | | | Electives | | (6) | 6 | 12 | 18 |
| | | 16 | 19 | 28 | 47 | | | 16 | 18 | 29 | 47 |

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Philosophy | 8 | (3) | 3 | 6 | 9 | Philosophy | 9 | (3) | 3 | 6 | 9 |
| French or German | 97 / 77 | (3) | 3 | 6 | 9 | French or German | 97 / 77 | (3) | 3 | 6 | 9 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| Electives | | (10) | 10 | 20 | 30 | Electives | | (10) | 10 | 20 | 30 |
| | | 17 | 18 | 32 | 50 | | | 17 | 18 | 32 | 50 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## ELECTIVE STUDIES

In order that elective subjects may be incorporated, so far as possible, in the University roster from term to term without conflicts, students are required to submit their electives to the professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15.

### SOPHOMORE ELECTIVES

| FIRST TERM | | SECOND TERM | |
|---|---|---|---|
| Advanced Algebra (4) | 143 | Plane Analytic Geom. (3) | 145 |
| European History (3) | 41 | European History (3) | 42 |
| Elementary Mechanics (3) | 320 | Mechanics & Heat (3) | 321 |
| Latin (3) | 48 | Physical Measurements (1) | 322 |
| Greek (3) | 64 or 65 | Latin (3) | 49 |
| Advanced Chemistry (3) | 398 | Greek (3) | 64 or 65 |
| Economic Geography (3) | 35 | Advanced Chemistry (3) | 399 |
| Physiography (2) | 277 | Economic Geography (3) | 35 |
| French (3) | 92 | Physiology (2) | 278 |
| or German (3) | 70 | French (3) | 92 |
| Education (3) | 11 | or German (3) | 71 |
| English (3) | 132 | Scientific Method (3) | 10 |
| | | Spherical Trigonometry (1) | 142 |
| | | Stoichiometry (1) | 397 |
| | | English (3) | 133 |
| | | Education (3) | 12 |

### JUNIOR ELECTIVES

| FIRST TERM | | SECOND TERM | |
|---|---|---|---|
| U. S. History (3) | 39 | U. S. History (3) | 40 |
| Latin (3) | 50 or 52 | Latin (3) | 51 or 53 |
| Greek (3) | 55, 59 or 61 | Greek (3) | 56, 60 or 62 |
| French (3) | 98, 100 or 102 | French (3) | 99, 101 or 102 |
| or German (3) | 78, 77 or 80 | or German (3) | 79, 77 or 80 |
| Spanish (3) | 110 | Spanish (3) | 110 |
| Dif. Cal. & S. A. Geom. (4) | 146 | Integral Calculus (4) | 147 |
| Higher Algebra (1) | 144 | Physics (3) | 333 |
| Physics (3) | 333 | Quantitative Analysis (5) | 404, 405 |
| Quantitative Analysis (5) | 400, 402 | Constitutional Law (3) | 33 |
| Constitutional Law (3) | 33 | Comparative Anatomy (3) | 293 |
| English (3) | 126, 129, 130 or 132 | English (3) | 128, 131, 133 or 134 |
| Mineralogy (4) | 266 | Education (3) | 14 |
| Education (3) | 13 | Education (1-3) | 16 |
| Education (1-3) | 16 | Italian (3) | 117 |
| Italian (3) | 117 | Economic Geography (3) | 36 |
| Economic Geography (3) | 36 | Business Law (2) | 32 |
| Business Law (2) | 31 | Labor Legislation (3) | 23 |
| Labor Legislation (3) | 23 | Geological Lab. (2) | 269 |

### SENIOR ELECTIVES

| FIRST TERM | | SECOND TERM | |
|---|---|---|---|
| Latin (3) | 50 or 52 | Latin (3) | 51 or 53 |
| Greek (3) | 57, 59 or 61 | Greek (3) | 58, 60 or 62 |
| German (3) | 81 or 82 | German (3) | 81 or 82 |
| French (3) | 100, 102, 103 or 104 | French (3) | 101, 102, 103 or 104 |
| Italian (2) | 118 | Italian (3) | 118 |
| Spanish (3) | 114 | Spanish (3) | 114 |

| | |
|---|---|
| English (3) | 126, 129, 130 or 132 |
| Organic Chemistry (5) | 408, 409 |
| Banking (3) | 27 |
| Education (1-3) | 16 |
| Psychology (3) | 3 |
| Embryology (3) | 294 |
| Bacteriology (2) | 296 |
| Experimental Psychology (1) | 7 |
| Finance (3) | 19 |
| International Law (3) | 34 |
| Physics (3) | 334 or 335 |
| Physics Lab. (2) | 337 |
| Analytic Mechanics (2) | 149 |
| Field Geology (3) | 275 |
| Petrography (2) | 276 |
| Differential Equations (1) | 148 |
| Adv. Elec. & Mag. (2) | 327 |
| Electrical Laboratory (1) | 328 |
| Economic Thought (3) | 24 |

| | |
|---|---|
| English (3) | 128, 131, 132 or 134 |
| Organic Chemistry (4) | 410 |
| Organic Chem. Lab. (3) | 411 |
| Banking (3) | 27 |
| Education (3) | 15 |
| Education (1-3) | 16 |
| Botany (3) | 290 |
| Physiology (2) | 298 |
| Advanced Bacteriology (2) | 297 |
| Psychlogy (3) | 4 |
| Experimental Psychology (1) | 7 |
| Finance (3) | 19 |
| International Law (3) | 34 |
| Physics (3) | 334 or 336 |
| Physics Lab. (2) | 337 |
| Astronomy (3) | 150 |
| Paleontology (3) | 272 |
| Geology of N. A. (3) | 273 |
| Electrical Laboratory (1) | 329 |
| Analytic Mechanics (3) | 152 |
| Economic Thought (3) | 24 |

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

### PREPARATION FOR ENGINEERING COURSES

If a student in the College of Arts and Science contemplates becoming a candidate for a degree in engineering after the completion of his B.A. course, he should choose as electives during the third and fourth years of his B.A. course such science studies as are contained in the first and second years of the technical curriculum which he wishes afterwards to complete. By carefully selecting electives, with the advice and guidance of the head of his department and the professor in charge of the technical curriculum concerned, the graduate of the B.A. course may enter the technical course chosen as a junior in full standing, and obtain his technical degree in two years of further study.

### PRE-MEDICAL CURRICULA

Certain medical schools require for entrance a college course in addition to a high school course; others require a high school course yielding fourteen or more college entrance credits and at least two years in a college of liberal arts with about three-fourths of the study devoted to chemistry, physics, and biology.

The following four-year curriculum has been prepared for students who intend to enter a medical school, but plan, before doing so, to complete their college course and obtain their degree.

# THE PRE-MEDICAL CURRICULUM

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | 120, 121 | (3) | 3 | 6 | 9 | English | 122, 125 | (3) | 3 | 6 | 9 |
| Plane Trig. | 141 | (3) | 3 | 6 | 9 | Solid Geom. | 140 | (3) | 3 | 6 | 9 |
| German or French | 77 or 70 / 98 | (3) | 3 | 6 | 9 | German or French | 77 or 71 / 99 | (3) | 3 | 6 | 9 |
| Latin or A. & M. Civil. | 45 or 54a / 47 | (3) | 3 | 6 | 9 | Latin or A. & M. Civil. | 46 or 54b / 47 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (2) | 6 | 1 | 7 |
| Chem. Lab. | 391or393a | (2) | 6 | 0 | 6 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 30 | 54 | | | 17 | 23 | 28 | 51 |

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND YEAR | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | 123 | (3) | 3 | 6 | 9 | English | 124 | (3) | 3 | 6 | 9 |
| or French / German | 100 / 78 or 77 | (3) | 3 | 6 | 9 | German or French | 79 or 77 / 101 | (3) | 3 | 6 | 9 |
| Economics | 16 | (3) | 3 | 6 | 9 | Economics | 17 | (3) | 3 | 6 | 9 |
| Physics | 331 | (3) | 5 | 4 | 9 | Physics | 331 | (3) | 5 | 4 | 9 |
| Adv. Chem. | 398 | (3) | 3 | 3 | 6 | Adv. Chem. | 399 | (3) | 3 | 6 | 9 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 17 | 21 | 27 | 48 | | | 17 | 21 | 30 | 51 |

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Psychology | 1 | (3) | 3 | 6 | 9 | Psychology | 1 | (3) | 3 | 6 | 9 |
| French or German | 90 or 98 / 70 | (3) | 3 | 6 | 9 | French or German | 90 or 99 / 71 | (3) | 3 | 6 | 9 |
| Biology | 292 | (5) | 9 | 6 | 15 | Comp. Anat. | 293 | (3) | 5 | 4 | 9 |
| Quant. Anal. | 400 | (3) | 9 | 0 | 9 | Quant. Anal. | 404 | (3) | 9 | 0 | 9 |
| Quant. An. Conf. | 402 | (1) | 1 | 2 | 3 | Quant. An. Conf. | 405 | (1) | 1 | 2 | 3 |
| Physics | 332 | (2) | 2 | 4 | 6 | Physics | 332 | (2) | 2 | 4 | 6 |
| Physical Ed. | 400 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 18 | 29 | 24 | 53 | | | 16 | 25 | 22 | 47 |

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Philosophy | 8 | (3) | 3 | 6 | 9 | Philosophy | 9 | (3) | 3 | 6 | 9 |
| French or German | 97 or 100 / 77 | (3) | 3 | 6 | 9 | French or German | 97 or 101 / 77 | (3) | 3 | 6 | 9 |
| Org. Chem. | 408 | (3) | 3 | 6 | 9 | Org. Chem. | 410 | (4) | 4 | 5 | 9 |
| Org. Chem. Lab. | 409 | (2) | 6 | 0 | 6 | Org. Chem. Lab. | 411 | (2) | 6 | 0 | 6 |
| Embryology | 294 | (3) | 5 | 4 | 9 | Botany | 290 | (3) | 4 | 4 | 8 |
| Bacteriology | 296 | (2) | 3 | 3 | 6 | Psychology | 4 | (3) | 3 | 6 | 9 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 17 | 25 | 25 | 50 | | | 19 | 25 | 27 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

For students who cannot devote four years to college work preparatory to entering upon the study of medicine, there may be arranged upon consultation, a course which will give the student in two or three years the credits demanded by the medical schools for admission.

### PREPARATION FOR TEACHING

In the curriculum leading to the degree of Bachelor of Arts, outlined on pages 28 to 30, the student may, through a selection of suitable electives, equip himself to teach in the high school the subject or subjects he has selected as his specialty, whether in the field of English, of ancient or modern languages, of history and social science, of biology and chemistry, of physics and mathematics, or of physiography and related subjects. In the curriculum in Business Administration he is permitted to substitute, during the junior and senior years, courses in distinctly pedagogical subjects sufficient to make a total of eighteen term hours. He may thus equip himself to teach in secondary schools the important branches of commerce and industry.

No one may teach in the public schools of any state without first securing a license from that state. In Pennsylvania, as in most states, the special examination for such a license is waived in the case of college graduates, provided they have completed a certain number of hours in distinctly pedagogical studies and have applied for a provisional college certificate to teach. At the end of three years of successful experience in teaching the State of Pennsylvania issues a permanent college certificate.

The requirement in this State for a provisional college graduate certificate to teach is as follows:

| | |
|---|---|
| Professional Training, | Eighteen semester hours |
| Introduction to Teaching, | Three semester hours |
| Educational Psychology, | Three semester hours |
| Practice Teaching, | Six semester hours |
| Elective professional studies, | Six semester hours |
| Study of subject matter, | Twelve semester hours in each subject in which the candidate desires certification |

The course in education at Lehigh University amply meets these requirements. It may be outlined thus:

| FIRST TERM | SOPHOMORE YEAR | SECOND TERM |
|---|---|---|
| Introduction to Teaching | (3) | History of Education (3) |
| **FIRST TERM** | **JUNIOR YEAR** | **SECOND TERM** |
| General Psychology | (3) | Educational Psychology (3) |
| Principles of Secondary Education | (3) | School Efficiency (3) |
| Practice Teaching | (1) | Practice Teaching (1) |
| **FIRST TERM** | **SENIOR YEAR** | **SECOND TERM** |
| Special Method | (1) or (2) | Special Method (1) or (2) |
| Practice Teaching | (2) | Problems of Secondary Education (3) |
| Educational Psychology (advanced) | (3) | Practice Teaching (2) |

While all these courses are ordinarily given each year, it should be understood that to secure the Provisional College Certificate to teach in Pennsylvania High Schools a student need complete only Introduction to Teaching, Educational Psychology, for which General Psychology is a prerequisite, Practice Teaching, and two of the following: Principles of Secondary Education, Special Method, History of Education, Problems of Secondary Education, School Efficiency, and Advanced Educational Psychology.

Through the courtesy and public spirit of the Boards of Education, Superintendents of Schools, and principals and teachers of the neighboring high schools, the plan of practice teaching outlined under course 16 has worked out well. These schools provide not only modern well equipped buildings but also excellent organization and teachers well fitted to serve as models and critic teachers for students in education. The students of Lehigh University are cordially welcomed, and have abundant opportunity for observation, with some facilities for practice.

Students who expect to teach upon graduation are urged to get in touch with the Department of Education early in their college career. The proper selection of studies is of great importance to future success, and by the beginning of the sophomore year the student should, if possible, decide upon one subject for his specialty and a second subject, preferably though not necessarily related to the first, for a second string to his bow. While the State requires only that twelve semester hours be

given to each subject in which the applicant will be certificated, it is safe to say that the specialty should receive not much less than twice this amount of attention.

It is desirable that during the junior year, the student should secure the thorough review of the elements of his specialty that is furnished by the courses in Special Method. The best practice teaching cannot be done by a man who is weak in the fundamentals of his subject through lack of recent review.

The department has prepared a "self-estimate" card, which enumerates the qualities that are most important in a teacher and some of the defects that are most dangerous. The student is encouraged to rate himself, and to study how to make the most of his talents and how to remedy his defects. Appearance and manner, the use of English, self-control, interest in and sympathy with other people and especially with the young, physical health, interest in the sports and other activities of high school students, ideals of scholarship, loyalty, and co-operation, professional purpose—these are some of the personal elements which a student who hopes to teach is invited to study in this way.

Whether in large or small high schools, the young teacher often finds opportunity to guide his pupils in wholesome sport and recreation. The Department of Physical Education is giving to students training that should greatly add to their value in the teaching profession.

# THE COLLEGE OF BUSINESS ADMINISTRATION

The first function of the College of Business Administration is to provide for students intending to enter business rather than the professions thorough training in the principles which underlie all business activity. With this end in view the College offers to students meeting the entrance requirements outlined on page 19 a complete four-year curriculum leading to the degree of Bachelor of Science in Business Administration. The curriculum covers the fundamental economic principles that control the growth and operation of industrial and commercial enterprises, the general laws that determine prosperity and economic progress, and the basic facts of accounting, finance, and statistics that are applicable to all business.

The curriculum is not intended to equip students for the management of enterprises or the holding of responsible business positions immediately after graduation. The College of Business Administration makes no attempt to provide a substitute for the training and experience in the complex details of any particular business that can be gained only from actual contact with that business. The primary aim is to develop in the student an intelligent understanding of basic facts and principles, an ability to analyze industrial and commercial phenomena, and a habit of thought that will enable him in later life to cope with the practical problems increasing executive responsibility will bring. Above all, the course is intended to give the student such familiarity with various types of business that he can intelligently choose the special branch in which he is most likely to succeed, without trusting to the wholly fortuitous hazards of personal connections and opportunity.

The course is so arranged that the freshman year is largely devoted to the work in mathematics, English, and foreign languages which is essential as a background for the specialized work of the succeeding years. The sophomore year is given chiefly to the work in economic theory and accounting principles which is fundamental to any understanding of business. The junior and senior years include advanced work in special and

more technical aspects of business, such as banking, corporation management, economic resources, labor problems, statistics, accounting methods, and business law.

A second function of the College of Business Administration is to afford to students in the College of Arts and Sciences and in the various engineering curricula of the University an opportunity to receive instruction in the fundamental facts and principles of economics, now recognized as a necessary part of the curriculum of all college students, whether in the more generalized cultural curricula or in the highly specialized professional engineering fields.

# THE CURRICULUM IN BUSINESS ADMINISTRATION

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | 120, 121 | (3) | 3 | 6 | 9 | English | 122, 125 | (3) | 3 | 6 | 9 |
| Spanish ..110 or 111 or Portuguese..115 | | (3) | 3 | 6 | 9 | Spanish ..110 or 111 or Portuguese..115 | | (3) | 3 | 6 | 9 |
| Indus. Hist. | 38 | (4) | 4 | 8 | 12 | Indus. Hist. | 38 | (4) | 4 | 8 | 12 |
| Plane Trig. | 141 | (3) | 3 | 6 | 9 | Solid Geom. | 140 | (3) | 3 | 6 | 9 |
| Engr. Draw. | 160 | (3) | 7 | 1 | 8 | Engr. Draw. | 161 | (2) | 5 | 1 | 6 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 29 | 53 | | | 17 | 22 | 29 | 51 |

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND YEAR | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Physiography | 277 | (2) | 2 | 4 | 6 | Physiography | 278 | (2) | 2 | 4 | 6 |
| Accounting | 20 | (3) | 3 | 6 | 9 | Accounting | 20 | (3) | 3 | 6 | 9 |
| Const. Law. | 33 | (3) | 3 | 6 | 9 | Const. Law. | 33 | (3) | 3 | 6 | 9 |
| Economics | 16 | (3) | 3 | 6 | 9 | Economics | 17 | (3) | 3 | 6 | 9 |
| Ec. Geog. N.&S.A. | 35 | (3) | 3 | 6 | 9 | Ec. Geog. N.&S.A. | 35 | (3) | 3 | 6 | 9 |
| Spanish ..112 or 113 or Portuguese..116 | | (3) | 3 | 6 | 9 | Spanish ..112 or 113 or Portuguese..116 | | (3) | 3 | 6 | 9 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 19 | 21 | 36 | 57 | | | 19 | 21 | 36 | 57 |

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bus. Law | 31 | (2) | 2 | 4 | 6 | Bus. Law. | 32 | (2) | 2 | 4 | 6 |
| U. S. Hist. | 39 | (3) | 3 | 6 | 9 | U. S. Hist. | 40 | (3) | 3 | 6 | 9 |
| Labor Legis. | 23 | (3) | 3 | 6 | 9 | Labor Legis. | 23 | (3) | 3 | 6 | 9 |
| Transportation | 22 | (2) | 2 | 4 | 6 | Transportation | 22 | (2) | 2 | 4 | 6 |
| Statistics | 26 | (3) | 3 | 6 | 9 | Statistics | 26 | (3) | 3 | 6 | 9 |
| Corp. Acct. (Elec.) | 21 | (3) | 3 | 9 | 12 | Corp. Acct. (Elec.) | 21 | (3) | 3 | 9 | 12 |
| Corp. Fin. (Elec.) | 18a | (3) | 3 | 8 | 11 | Corp. Fin. (Elec.) | 18a | (3) | 3 | 8 | 11 |
| Ec. Geog. E. H. | 36 | (3) | 3 | 6 | 9 | Ec. Geog. E. H. | 36 | (3) | 3 | 6 | 9 |
| Psychology | 5 | (2) | 2 | 4 | 6 | Psychology | 2 | (2) | 2 | 4 | 6 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Psychology | 6 | (2) | 2 | 4 | 6 |
| | | 19 | 20 | 36 | 56 | | | 19 | 20 | 36 | 56 |

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Finance | 19 | (3) | 3 | 6 | 9 | Finance | 19 | (3) | 3 | 6 | 9 |
| Bank. & Cur. | 27 | (3) | 3 | 6 | 9 | Bank. & Cur. | 27 | (3) | 3 | 6 | 9 |
| Investments | 25 | (3) | 3 | 6 | 9 | Investments | 25 | (3) | 3 | 6 | 9 |
| Audit. (Elec.) | 21a | (3) | 3 | 9 | 12 | Cost Acct. (Elec.) | 21b | (3) | 3 | 9 | 12 |
| European Hist. | 41 | (3) | 3 | 6 | 9 | European Hist. | 42 | (3) | 3 | 6 | 9 |
| Internat. Law | 34 | (3) | 3 | 6 | 9 | Internat. Law | 34 | (3) | 3 | 6 | 9 |
| Econ. Thought | 24 | (3) | 3 | 6 | 9 | Econ. Thought | 24 | (3) | 3 | 6 | 9 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Thesis | 44 | (3) | 0 | 9 | 9 |
| | | 19 | 20 | 36 | 56 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | | | | | | | 22 | 20 | 45 | 65 |

Students may, with the approval of the Faculty, substitute for some of the subjects in the junior and senior years other subjects which will better suit their future aims.

Prospective teachers should in this connection read the statement concerning Courses for Teachers.

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

# THE COLLEGE OF ENGINEERING

## THE CURRICULUM IN CIVIL ENGINEERING

The requirements for admission to the curriculum in Civil Engineering are given on page 20.

The purpose of this curriculum is to give a broad education in those general and scientific subjects which form the foundation of all engineering, and a special training in the field of Civil Engineering, which covers the building of highways, railroads, harbors, docks and terminals, bridges, buildings, foundations, subways, tunnels, water supply and purification plants, sewerage systems and sewage disposal plants, water power development, and surveying. The Department aims to teach young men how to think and how to attack new problems, to impress upon them the underlying principles of engineering, and to inspire them with the desire to do their best work.

To enable the Civil Engineering graduate to deal with allied engineering problems arising in most Civil Engineering projects of today, the course includes certain special studies such as dynamos and motors, alternating currents, heat engines, metallurgy, mineralogy, and geology. Courses in Business Administration, comprising economics, accounting, business law, and finance, have been placed in the curriculum with the idea that the graduate should have a knowledge of the fundamentals of business. These business subjects should prove useful to young graduates whose advancements may be along sales, managerial, and executive channels. The general scope of the Civil Engineering curriculum, including as it does mathematics, pure and applied science, general engineering, and business subjects, affords a thorough training in system, arrangement of work, accuracy in figures, and logical thinking, so that the student has the proper training to enter not only the engineering profession, but also any business organization, should he not care to follow strictly engineering work.

The first two years are devoted mostly to fundamental studies which both give general culture and prepare for the technical work of the following years. These studies include the various branches of pure mathematics, physics, chemistry, English, modern

languages, drawing, descriptive geometry, mineralogy, geology, and military science and tactics.

In the summer school, at the close of the sophomore year, Land, Topographic, and Railroad Surveying is given. This covers a period of six weeks, and by this arrangement the attention of students is concentrated upon surveying, thus enabling practical field operations to be exemplified in the best manner. In Geodetic Surveying, given in the senior year, triangulations of a high degree of precision are executed. Also determinations of azimuth and adjustments of results are made by standard methods. A large collection of levels, transits, and other surveying instruments enables the student to become familiar with instruments of the best type.

Mechanics of Materials, which presents the theory of beams, columns, and shafts, and the method of computing and designing them, is given in the junior year. The course as here presented may be described as applied mechanics, that is, the application of mechanics to the design of engineering structures. Materials Testing Laboratory, paralleling Mechanics of Materials, is of great importance for the student's understanding of the mechanics of engineering and for the capacity it gives him to manipulate apparatus and to handle machines. Tests are made on the various materials used in construction.

Buildings and bridges receive attention throughout three terms. Analytical and graphic methods of determining stresses are taken up in Roofs and Bridges of the second term of the junior year and in Bridge and Structural Design and Higher Structures of the senior year. Visits are made to bridges and fabricating shops. In the senior year designs and working drawings are prepared by each student for both a highway and a railroad bridge. Some of these drawings are made in the same manner as in drawing rooms of bridge companies and others are general, that is, design drawings only. The theory of cantilever, draw, suspension, and arch structures receives detailed attention. Structural Steel Design as applied to building construction is studied in detail. The design and construction of reinforced concrete and foundations are given in the second term of the senior year in the course in Reinforced Concrete Design and Foundations. This extended training in

structural engineering furnishes a foundation for structural steel and reinforced concrete work in practice.

Hydraulic Engineering and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the junior year, the work being supplemented by testing in the hydraulic laboratory. In the senior year the subjects of water supply, water power, and sewerage are covered in detail. The methods of collecting, purifying, and distributing water are explained and compared; house drainage, the design of sewerage systems, and the disposal of sewage also receive attention. Computations for dams, stand-pipes, sewers, and other appurtenances are made. Canal engineering, river and harbor work, and land drainage are studied; irrigation by both water and sewage is discussed. This training in Hydraulics and Sanitary Engineering subjects, including Sanitary Biology of the senior year, is planned to enable a graduate to enter upon the work of city engineering. In connection with the course in Hydraulics, measurements are made of the flow in the Lehigh River, the Lehigh Canal, and other streams in the vicinity of Bethlehem, and the data thus obtained are studied later and reports written thereon. In view of the increasing importance of water power development this work is of value and interest.

The contents of the courses in Highway Engineering and Railroads are planned to prepare a student to enter the field of highway construction and design and railroad work.

Contracts and Specifications of the second term of the senior year is presented by the Civil Engineering Department more from the engineering than from the legal viewpoint. This course, consisting of two lectures a week, gives the essential features of contracts and the form and scope of contracts and specifications as used in building engineering works.

A description of the Fritz Engineering Laboratory, which is operated by the Civil Engineering Department, is given in this Register under the heading of Buildings.

The student who completes the curriculum receives the degree of Civil Engineer (C.E.). Mature young men, if properly qualified, may take special studies without being candidates for the degree.

# THE CURRICULUM IN CIVIL ENGINEERING

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal. Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (2) | 6 | 1 | 7 |
| Chem. Lab. | 391 or 393a | (2) | 6 | 0 | 6 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| French / or German / or Spanish | 94 / 75 / 111 | (3) | 3 | 6 | 9 | Phys. Measure | 322 | (1) | 3 | 2 | 5 |
| English | 120 | (2) | 2 | 2 | 4 | French / or German / or Spanish | 94 / 75 / 111 | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | English | 122 | (2) | 2 | 2 | 4 |
| | | 18 | 24 | 27 | 51 | Drawing | 162 | (1) | 3 | 0 | 3 |
| | | | | | | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | | | | | | | 18 | 28 | 23 | 51 |

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND YEAR | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S.A.Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound. | 324 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| Mineralogy | 266 | (4) | 6 | 3 | 9 | Gen. Geology | 268 | (2) | 2 | 3 | 5 |
| Heat Eng. | 221 | (3) | 3 | 6 | 9 | Geol. Lab. | 269 | (2) | 4 | 3 | 7 |
| Engr. Drawing | 163 | (3) | 7 | 1 | 8 | Heat Eng. | 222 | (3) | 3 | 6 | 9 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | Engr. Drawing | 164 | (2) | 5 | 0 | 5 |
| | | 20 | 29 | 25 | 54 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | | | | | | | 19 | 27 | 27 | 54 |

SUMMER TERM: Land and Topographic Surveying, 165, 4 weeks (3); Railroad Surveying, 166, 2 weeks (1½)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mech. of Mat. | 167 | (4) | 4 | 8 | 12 | Hydraulics | 170 | (3) | 3 | 6 | 9 |
| Mat. Test. Lab. | 168 | (1) | 3 | 0 | 3 | Hyd. Lab. | 171 | (1) | 3 | 0 | 3 |
| Anal. Mech. | 149 | (2) | 2 | 4 | 6 | Roofs & Bridges. | 172 | (4) | 4 | 8 | 12 |
| Railroads | 169 | (4) | 8 | 2 | 10 | Astronomy | 150 | (3) | 3 | 6 | 9 |
| Metallurgy | 247 | (3) | 3 | 4 | 7 | Alt. Cur. | 375 | (2) | 2 | 4 | 6 |
| Dyn. & Mot. | 354 | (2) | 2 | 4 | 6 | Dyn. Lab. | 356 | (1) | 3 | 1 | 4 |
| Dyn. Lab. | 355 | (1) | 3 | 1 | 4 | Highway Engr. | 173 | (3) | 5 | 2 | 7 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 18 | 27 | 23 | 50 | | | 18 | 25 | 27 | 52 |

SUMMER TERM: Shop Work or Engineering Construction, with report, 187, 8 weeks (3)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Str. Steel Des. | 175 | (3) | 3 | 6 | 9 | Higher Structures. | 182 | (3) | 3 | 6 | 9 |
| Br. Des. Dr. | 177 | (3) | 9 | 0 | 9 | R. Con. D. & F. | 183 | (3) | 3 | 6 | 9 |
| Hyd. &W.P.Engr. | 179 | (4) | 5 | 7 | 12 | Cement Lab. | 184 | (1) | 3 | 0 | 3 |
| Geodesy | 180 | (3) | 6 | 2 | 8 | San. Engr. | 186 | (3) | 3 | 6 | 9 |
| or Pract. Astr. | 151 | (3) | 3 | 6 | 9 | San. Biol. | 295 | (2) | 3 | 5 | 8 |
| Bus. Engr. | 30a | (3) | 3 | 3 | 6 | English | 137 | (3) | 3 | 3 | 6 |
| R. Rs. & Ter. | 181 | (3) | 3 | 3 | 6 | or Con. & Spec. | 185 | (2) | 2 | 4 | 6 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Bus. Engr. | 30a | (3) | 3 | 3 | 6 |
| | | 20 | 31 | 21 | 52 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | | | | | | | 19 | 23 | 29 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN MECHANICAL ENGINEERING

The requirements for admission to the Curriculum in Mechanical Engineering are given on page 20.

The purpose of this course is to give young men a broad and thorough training in the fundamental subjects which underlie all engineering.

The freshman year is given to fundamental studies in preparation for the technical work of the following years and to studies of general culture value. The former comprise Advanced Algebra, Analytic Geometry, Elementary Chemistry with laboratory exercises, Qualitative Analysis, Stoichiometry, Elementary Mechanics, Heat, and laboratory work in Physical Measurements. The general studies are English, Military Science and Tactics, and modern languages—French, German, or Spanish. Students continue the language accepted for entrance.

At the close of the freshman year, students attend the R. O. T. C. encampment for six weeks or spend eight weeks in an industrial plant and hand in a report at the beginning of the sophomore year.

In the sophomore year the following courses are given: Differential Calculus, Solid Analytic Geometry, Integral Calculus, Electricity and Magnetism, Light and Sound, Mechanism, Mechanical Drawing, Elementary Machine Design, and Steam Engines. The laboratory course covers mechanics, heat, light, electricity, and magnetism. Military Science and Tactics is continued.

At the close of the sophomore year students are required to spend eight weeks in an industrial plant and to hand in a report at the beginning of the junior year.

The courses given in the junior year are Differential Equations, Analytic Mechanics, Mechanics of Materials, Graphic Statics of Mechanisms, Advanced Electricity and Magnetism, Heat Engines, Hydraulics, Metallurgy, Graphic Statics of Structures, Surveying, and Dynamos and Motors. Courses are given in Engineering Laboratory and Electrical Laboratory; laboratory courses also accompany the study of Mechanics of Materials and Hydraulics.

At the close of the junior year students are required to spend at least eight weeks on student apprenticeship work, shop work,

or engineering construction as approved by the Department. A report is required.

The courses of the senior year are Machine Design, Alternating Currents and Electrical Engineering, both accompanied by laboratory work, Mechanical Engineering, English, Business Engineering, and Engineering Laboratory. A thesis is required.

The course in Mechanical Engineering is built upon the work of the sophomore and junior years and consists of Thermodynamics, Steam Turbines, Internal Combustion Engines, Air Machinery, Pumping Machinery, and Refrigeration.

The course in Business Engineering comprises the elements of Economics, Accounting, Business Law, and Finance.

Instruction in Machine Design is given throughout the sophomore year. There is a thorough drill in projection drawing. Freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. There is then considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice. In their senior year the students undertake the calculations, estimates, and working drawings involved in the design of simple but complete machines, the general plan of arrangement being given in the form of rough sketches, photographs, or wood cuts. In the second term the seniors make original designs for simple machinery.

After completing the general course in Physics, students in Mechanical Engineering take courses along electrical lines. The aim is a clear conception of electrical units and a working knowledge of resistance, impedance, reactance, capacity, the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current apparatus. Practical problems show their application. The laboratory work involves tests of resistance, insulation, consumption of energy, and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering. The simpler tests and experiments are taken up next, and there is a gradual progress toward complex operations such as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam traps and separators, of injectors, pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts, and boiler testing are included.

Due place is given in the course to gas engineering, tests of gas producers, gas engines, and oil engines, work with compressed air, tests of hot-air engines, and various incidental appliances and apparatus. Dynamometer work includes experiments in friction and lubrication and determination of the efficiency of machines. The purpose of this course is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student, and give training in the idea, method, and detail of this sort of work.

In the senior year one trip is made to New York or Philadelphia, during which visits of inspection are made to power plants, municipal works, ship yards, and a variety of industrial plants located in these cities or the vicinity. This trip is required of all students who are candidates for a degree. The minimum expense is about twenty-five dollars.

Graduates of this curriculum receive the degree of Mechanical Engineer (M.E.).

# THE CURRICULUM IN MECHANICAL ENGINEERING

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal. Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (3) | 9 | 1 | 10 |
| Chem. Lab. | 391or393a | (2) | 6 | 0 | 6 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| French / or German / or Spanish | 94 / 75 / 111 | (3) | 3 | 6 | 9 | Phys. Measure | 322 | (1) | 3 | 2 | 5 |
| English | 120 | (2) | 2 | 2 | 4 | French / or German / or Spanish | 94 / 75 / 111 | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | English | 122 | (3) | 3 | 2 | 5 |
| | | | | | | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 27 | 51 | | | 19 | 28 | 23 | 52 |

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3); or Industrial Plant work, 8 weeks, with report (3)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S.A.Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound | 325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| Dr. and El.M.Des. | 200 | (3) | 3 | 6 | 9 | El. Mach. Des. | 203 | (3) | 3 | 6 | 9 |
| Heat Eng. | 201 | (3) | 3 | 6 | 9 | Heat Eng. | 204 | (3) | 3 | 6 | 9 |
| Mechanism | 202 | (3) | 3 | 5 | 8 | Mechanism | 205 | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 19 | 22 | 32 | 54 | | | 19 | 22 | 32 | 54 |

SUMMER TERM: Work in Industrial Plant, with report, 227, 8 weeks (3)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Diff. Equations | 148 | (1) | 1 | 3 | 4 | Metallurgy | 247 | (3) | 3 | 4 | 7 |
| Anal. Mech. | 149 | (2) | 2 | 4 | 6 | Hydraulics | 170a | (2) | 2 | 4 | 6 |
| Mech. of Mat. | 167a | (3) | 3 | 6 | 9 | Hyd. Lab. | 171 | (1) | 3 | 0 | 3 |
| Mat. Test. Lab. | 168 | (1) | 3 | 0 | 3 | Gr. St. & Sur. | 174 | (3) | 3 | 6 | 9 |
| Gr. St. of Mech. | 206 | (2) | 4 | 0 | 4 | Dyn. & Mot. | 354 | (2) | 2 | 4 | 6 |
| Adv. Elec. & Mag. | 327 | (2) | 2 | 4 | 6 | Elec. Lab. | 329 | (1) | 3 | 1 | 4 |
| Elec. Lab. | 328 | (1) | 3 | 0 | 3 | Heat Eng. | 209 | (4) | 4 | 8 | 12 |
| Heat Eng. | 207 | (4) | 4 | 8 | 12 | Engr. Lab. | 210 | (1) | 3 | 0 | 3 |
| Engr. Lab. | 208 | (1) | 3 | 0 | 3 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | | | 18 | 25 | 27 | 52 |
| | | 18 | 27 | 25 | 52 | | | | | | |

SUMMER TERM: Student Apprenticeship or Engineering Construction or Shop Work, with report, 228, 8 weeks (3)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | 123, 125 | (3) | 3 | 3 | 6 | Mach. Design | 215 | (4) | 4 | 8 | 12 |
| Mach. Design | 211 | (4) | 4 | 8 | 12 | Elec. Engr. | 361 | (2) | 2 | 4 | 6 |
| Alt. Currents | 375 | (2) | 2 | 4 | 6 | Dyn. Lab. | 356 | (1) | 3 | 1 | 4 |
| Dyn. Lab. | 355 | (1) | 3 | 1 | 4 | Bus. Engr. | 30a | (3) | 3 | 3 | 6 |
| Bus. Engr. | 30a | (3) | 3 | 3 | 6 | Mech. Engr. | 216 | (4) | 4 | 8 | 12 |
| Mech. Engr. | 212 | (4) | 4 | 8 | 12 | Engr. Lab. | 217 | (1) | 3 | 0 | 3 |
| Engr. Lab. | 213 | (1) | 3 | 0 | 3 | Thesis | 214 | (3) | 1 | 6 | 7 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 19 | 24 | 27 | 51 | | | 19 | 22 | 30 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN METALLURGY

The requirements for admission to the Curriculum in Metallurgy are given on page 20.

The object of this curriculum is the preparation of the student for practice in the general field of metallurgy. It is recognized that the breadth of the subject is such that detailed instruction in any particular subdivision is precluded in the time limits imposed by a four-year course. Emphasis is therefore laid on the thorough training of the student in fundamentals. It is a fairly simple matter for a man thoroughly grounded in fundamental theory to make the necessary applications to actual practice after he gets into the field, but the acquisition of theory to bolster up a purely practical knowledge is a more difficult achievement.

The foundation of any engineering course must be a thorough training in mathematics, in chemistry, in physics, in economics, and in the use of English. The work along these lines is as full as the time available will permit. A large portion of the first two years of the curriculum is devoted to these subjects, while the last two years are given mainly to the application of these in the various technical subjects and in economics.

Collateral studies in other departments than metallurgy are liberally provided, such as Mineralogy, Blowpiping, General Geology, Geological Practice, and Economic Geology in the Department of Geology; Mechanical Drawing and Ore Dressing in the Department of Mining Engineering; Advanced Electricity and Magnetism, and Electrical Laboratory in the Department of Physics; Alternating Currents, Dynamos and Motors, Electrical Engineering, and Dynamo Laboratory in the Department of Electrical Engineering; Heat Engines, comprising the study of boilers, steam engines, gas engines, and internal combustion motors, and Engineering Laboratory, in the Department of Mechanical Engineering; Hydraulics and Mechanics of Materials, with laboratory testing, in the Department of Civil Engineering; Economics, in the College of Business Administration; and English.

Instruction is given in English composition and public speaking. The study of German or French for one year is required, the student continuing the language on which he enters; if a student enters with Spanish, he takes one year of German. The one year

of either German or French is supplemented in the senior year by a course in reading metallurgical German and French with the staff of the Department of Metallurgy.

The studies in chemistry, which are so important to the metallurgist, include Laboratory Experiments, Qualitative and Quantitative Analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including Gas Analysis and Assaying, along with courses in Stoichiometry, Advanced Chemistry, Physical Chemistry, and Physical Chemistry Laboratory. This instruction, together with the course in Physics and Physical Laboratory, constitutes the foundation on which the metallurgical instruction is based.

The special instruction in Metallurgy is begun by introductory courses of lectures on the history of metals, followed by a discussion of their economic and mechanical importance, their physical and chemical properties, including statistics of their production and details of the distribution of their ores and the geographical distribution and conditions of their production. Courses of lectures extending over two years take up in detail the general principles of metallurgy and their applications to specific cases. They begin with the general physical and chemical principles utilized in extracting metals from their ores and the manner in which they are applied, and are followed by a course of lectures on the Metallurgy of Iron and Steel, and by another course in the metallurgy of the other metals, copper, lead, silver, gold, etc., in which each metal is discussed in detail. A course of lectures follows in the principles of electrochemistry and their application in electrometallurgy, accompanied by laboratory investigations of these principles as well as the general principles of metallurgical processes, including methods of making physical and chemical measurements which are of value to the practicing metallurgist. A course in Metallography acquaints the student with the methods of studying, with the microscope and other instruments of precision, the physical properties, constitution, and structure of metals and alloys. The seminar in the senior year is intended to bring together the members of the Department and the students in the discussion of current metallurgical questions and problems and students' theses, and especially to give facility in presenting data

to others in clear, concise, and forceful English. Metallurgical articles in English and foreign languages are abstracted and presented. The student's presentation is goodnaturedly criticized by his fellows and instructors.

In order to press metallurgical principles upon the student's mind and in order to accomplish the most difficult of all teaching achievements, making the student think, the course includes a series of problems dealing with practical details of the metallurgical processes in an exact and quantitative manner, the data whenever possible being taken from every-day commercial practice, so that the results may give an insight into the quantitative relations that are fundamental to all metallurgical processes. The purpose is to train the student in quantitative thinking in metallurgy.

Information is crystallized in the minds of the students by laboratory exercises in which they are required to study the principles of chemical, physical, and mechanical metallurgy. Instruction is given in connection with this laboratory work with the object of teaching and encouraging the practice and application of research in metallurgy. The course is planned to emphasize the principles and subordinate the time-consuming manual operations. The course employs laboratory apparatus and is preliminary to thesis work, during which the students often have to apply the underlying principles they are studying to full-size operations and furnaces in commercial metallurgical works and foundries.

Through the kindness of the officials of the Bethlehem Steel Company, the students spend a total of about 15 to 20 afternoons of three hours each in the steel works, studying the operations in detail under the guidance of instructors, there being not more than six students to each instrucor. These visits are co-ordinated with a conference period; the students are informed in advance just what subjects are to be studied during each visit, and are required to report thereon in writing or verbally. Visits of inspection are also made to other metallurgical works and industrial plants, such as smelters and refineries of copper, lead, gold, silver, and zinc. Plants where heat treating of metals and alloys is practiced in an unusually well-developed manner, are also visited. Plants visited in 1923-24 included the U. S. Metals Re-

finery Company, the American Smelting & Refining Company, the By-Product Coke Plant of the Bethlehem Steel Company, the Plants and Research Laboratory of the New Jersey Zinc Company, the Philadelphia Navy Yard, the Naval Aircraft Factory, and others. The students also spend part of one summer vacation working in a metallurgical plant, but it is believed that employment activity of college students does not give the same facility in applying principles or the same keeness and observation as work under the immediate direction of instructors. In individual cases, however, so-called "industrial co-operative courses" have been arranged for special and graduate students.

# THE CURRICULUM IN METALLURGY

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal. Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (3) | 9 | 0 | 9 |
| Chem. Lab. | 391or393a | (2) | 6 | 0 | 6 | Qual. An. Conf. | 396 | (1) | 1 | 2 | 3 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| German or French | 72 or 76 / 94 | (3) | 3 | 6 | 9 | Hist. Metals | 241 | (1) | 1 | 1 | 2 |
| English | 120 | (2) | 2 | 2 | 4 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | Phys. Measure. | 322 | (1) | 3 | 2 | 5 |
| | | | | | | German or French | 72 or 76 / 94 | (3) | 3 | 5 | 8 |
| | | | | | | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 27 | 51 | | | | 18 | 28 | 23 | 51 |

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S.A. | Geom. 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Adv. Chem. | 398 | (3) | 3 | 3 | 6 | Adv. Chem. | 399 | (3) | 3 | 6 | 9 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound | 325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| Intro. Met. | 242 | (1) | 1 | 1 | 2 | Intro. Met. | 242 | (1) | 1 | 1 | 2 |
| Drawing | 300 | (2) | 6 | 0 | 6 | Gen. Geology | 268 | (2) | 2 | 3 | 5 |
| Mineralogy | 266 | (4) | 6 | 3 | 9 | Geol. Lab. | 269 | (2) | 4 | 3 | 7 |
| B. P. Anal. | 267 | (1) | 3 | 0 | 3 | B. P. Anal. | 267 | (1) | 3 | 0 | 3 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 21 | 32 | 22 | 54 | | | 19 | 26 | 28 | 54 |

SUMMER TERM: Quantitative Analysis, 403a, 5 weeks (3)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| G.Met.& Probs. | 243,244 | (3) | 3 | 4 | 7 | I.&S. & Probs. | 245,246 | (3) | 3 | 4 | 7 |
| Phys. Chem. | 419 | (3) | 3 | 3 | 6 | Phys. Chem. | 421 | (2) | 2 | 3 | 5 |
| Ore Dr. & Lab. | 302 | (3) | 3 | 3 | 6 | Dyn. & Mot. | 354 | (2) | 2 | 3 | 5 |
| Adv. Elec. & Mag. | 327 | (2) | 2 | 4 | 6 | Dyn. Lab. | 355 | (1) | 3 | 1 | 4 |
| Elec. Lab. | 328 | (1) | 3 | 0 | 3 | Elec. Lab. | 329 | (1) | 3 | 0 | 3 |
| Heat Eng. | 221 | (3) | 3 | 6 | 9 | Heat Eng. | 222 | (3) | 3 | 6 | 9 |
| Mech. of Mat. | 167a | (3) | 3 | 6 | 9 | Hydraulics | 170a | (2) | 2 | 4 | 6 |
| Mat. Test. Lab. | 168 | (1) | 3 | 0 | 3 | Hyd. Lab. | 171 | (1) | 3 | 0 | 3 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | English | 125, 127 | (4) | 4 | 4 | 8 |
| | | | | | | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 20 | 25 | 26 | 51 | | | 20 | 27 | 25 | 52 |

SUMMER TERM: Assaying, 413, 4 weeks (3)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N.F.Met.&Pr. | 248,249 | (3) | 3 | 4 | 7 | N.F.Met.&Pr. | 250,251 | (3) | 3 | 4 | 7 |
| Metallography | 257 | (3) | 7 | 1 | 8 | Met. Lab. | 256 | (2) | 4 | 2 | 6 |
| El. Chem. | 252 | (1) | 1 | 2 | 3 | El. Met. | 253 | (1) | 1 | 2 | 3 |
| El. Chem. Lab. | 255 | (1) | 2 | 1 | 3 | Seminary | 258 | (2) | 3 | 0 | 3 |
| Seminary | 258 | (3) | 4 | 2 | 6 | Elec. Engr. | 361 | (2) | 2 | 3 | 5 |
| Alt. Currents | 375 | (2) | 2 | 3 | 5 | Dyn. Lab. | 362 | (1) | 3 | 1 | 4 |
| Dyn. Lab. | 356 | (1) | 3 | 1 | 4 | Eng. Lab. | 226 | (1) | 3 | 0 | 3 |
| Phys. Chem. Lab. | 420 | (1) | 3 | 0 | 3 | Econ. Geol. | 271 | (4) | 5 | 5 | 10 |
| Engr. Lab. | 220 | (1) | 3 | 0 | 3 | Thesis | 259 | (3) | 1 | 8 | 9 |
| French or Ger. | 91 or 72 | (3) | 3 | 5 | 8 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | | | | | | |
| | | 20 | 33 | 19 | 52 | | | 20 | 27 | 25 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN MINING ENGINEERING

The requirements for admission in the Curriculum in Mining Engineering are given on page 20.

The object of this course is primarily to train a student for practice in the field of mining engineering. It is designed to give him the thorough fundamental training of an engineer and a breadth of education that will enable him readily to undertake work in the various lines of engineering frequently presented to one of his profession.

The course, therefore, places the graduate in the path of a large number of opportunities. Not only will he have had sufficient practice and training to enter upon the field of mining but he can pursue work in which geology and metallurgy play an important part, or undertake related engineering projects.

In the freshman year a foundation is laid in the fundamental subjects of mathematics, physics, chemistry, English, and modern foreign languages. The modern language pursued is the one presented for entrance. Lectures are given in physiology and hygiene and also in military science and tactics. Military drill and systematic physical exercise are required. Students who elect the Advanced Course in Military Science and Tactics take the R. O. T. C. Camp at the close of the sophomore year and may substitute it for Assaying.

The course in drawing begins in the second term of the freshman year. A student learns the use of drawing instruments, making tracings and blue prints and drawings of machine parts of simple construction, and solves problems in Descriptive Geometry.

The summer schools in Land and Topographic Surveying and in Mine and Railroad Surveying are held respectively at the close of the freshman and junior years. The second of these schools is conducted partly as an inspection trip in the mining regions; this gives practice in mine and railroad surveying and permits a study of mining operations and mining plants, from which data are secured exemplifying class room work and facilitating the course in Mining Design of the senior year.

The course in chemisrty begins in the first term of the freshman year and extends to the end of the sophomore year, with

the summer school in Assaying at the end of that year. Beginning with an introduction to general chemical theory and the elements supplemented by laboratory work, the subject is continued by Qualitative and Quantitative Analysis. Chemical problems and reactions are taught in Stoichiometry. The instruction includes the analysis of common ores, fuels, gases, and metallurgical products.

The course in Business Engineering in the senior year aims to present to the student the several economic, commercial, administrative, and legal aspects of conditions existing in the industrial world which are of particular concern to the engineering profession.

The importance of the conservation of the timber resources of the country and the preservation of wood against decay are treated in Forestry, together with the characteristics of the woods of the important timber species.

Mineralogy is introduced by a short course in Crystallography, in which models of crystals and mineral specimens are studied. The various means of identification are then applied to more difficult minerals, the determination of which may be assisted and effected by the work in Blowpipe Analysis.

In the courses in geology, the student studies the forms and structures of the rock masses of the earth's crust and the forces which modify them. A brief review of historical geology deals with the fossil life of the globe. Practice in Field Geology teaches the methods by which rock formations are accurately mapped. Economic Geology treats of the origin, mode of occurrence, and distribution of the metallic and non-metallic minerals and substances of commercial value in the earth. The course in Petrography enables the student to identify the common rock-forming minerals by the use of the microscope, especially when the constituents are too fine-grained to be determined by the eye alone. Practice in the petrographic and geological laboratory and in the field qualifies the student to recognize the main types of rocks.

Physiography treats of the classification of land forms and their geographical distribution, their relation to geologic structure, weather, and climate, and their influence upon the economic development of countries. The course in Geology of North

America discusses the geologic ages and the geographic distribution of the rocks of the continent and their structure and history, and includes studies of the great surveys that have been made. Paleontology reviews the life of past ages and includes the study and identification of fossils as a means of determining the age of rocks by the principles of stratigraphy.

The course in Heat Engines includes a practical study of boilers, steam and gas engines, and steam turbines; work in the Wilbur Engineering Laboratory includes tests and calculations of efficiencies and powers under varying conditions.

Mechanics of Materials treats of the theories which govern the strength of all kinds of common materials used in construction. Practice is given in computing and designing beams, columns, girders, etc. Hydraulics deals with the flow of liquids through orifices, mains, pipes, and channels, and with the principles of hydraulic motors; practical work in the Fritz Engineering Laboratory is a part of this course. Graphic Statics qualifies the student to compute the forces developed in roof trusses, bridges, and girders by the methods of graphical analysis.

The instruction in Mining Engineering is given during the junior and senior years, under the following subdivisions: prospecting, boring, mining or exploitation, haulage, hoisting, drainage, ventilation, lighting, first-aid, railroads, construction materials, and mine administration. These subjects treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the manner in which accidents may occur, means for guarding against them, and the treatment of injured persons, and the means by which mines are maintained in an economical condition from the viewpoint of mine owner and miner.

The subject of Ore Dressing, supplemented by work in the Coxe Mining Laboratory, deals with the processes by which ores and fuels, direct from the mine, are rendered marketable. Construction Materials treats of the materials used in roads and structures in and around mines, particular attention being given to the use of reinforced concrete construction. Mine Administration discusses the method of employing labor and of keeping accounts and mining principles and management.

The course in Oil and Gas Technology includes a study of the occurrence and distribution of petroleum and natural gas, the methods of prospecting, the means for obtaining them from the earth, and their storage and transportation.

In Mining Design the student employs principles studied and observations made as the basis for designs and working drawings of parts of mining plants to fulfill given conditions.

In Metallurgy the general principles of the subject, embracing fuels, furnaces, and processes are presented, followed by the metallurgy of iron and steel, copper, lead, gold, silver, zinc, tin, mercury, nickel, and aluminum. Electrochemistry and Electrometallurgy familiarize the student with the practical applications of electricity to metallurgical processes including electric-furnace practice. Visits of inspection are made to metallurgical plants in the vicinity, and also to those near New York City.

Dynamos and Motors and Alternating Currents extend over the entire senior year and embrace the study of the industrial applications of electricity which are of particular value to the mining engineer; practical work in the Dynamo Laboratory is included in these courses.

Thus the student of the Curriculum in Mining Engineering has studies in all the technical departments of the University, as well as in many of the departments of arts and science.

The facilities for exemplifying the work of the course are exceptional. Cement mills, cement, slate, and other quarries, and ore and coal mines are within easy distance, and in the city are the great works of the Bethlehem Steel Company. During the senior year all students in Mining Engineering are required to make inspection trips to the anthracite coal regions and to the metal mining districts of eastern Pennsylvania and of New Jersey. A voluntary inspection trip to the mines of the central northern part of the United States and southern Ontario last summer included the Lake Superior iron and copper region. This trip will probably be repeated in August-September, 1924.

The Department of Mining Engineering has exceptional facilities in the Eckley B. Coxe Mining Laboratory. A description of the Laboratory is given on pages 152 and 153 of this Register.

The expenses for the Inspection Trips required of all mining students are approximately as follows:

Three Metallurgical one-day trips—$15.00.

Regular Mine Surveying Summer School Trip, one week—$25.00.

Senior Mining and Geological Inspection Trip, four days—$25.00.

Voluntary Summer Inspection Trip, five weeks—$150.00.

Graduates of this Curriculum receive the degree of Engineer of Mines (E. M.).

# THE CURRICULUM IN MINING ENGINEERING

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal. Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (3) | 9 | 1 | 10 |
| Chem. Lab. | 391 or 393a | (2) | 6 | 0 | 6 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| French or German or Spanish | 94 or 75 or 111 | (3) | 3 | 6 | 9 | Phys. Measure | 322 | (1) | 3 | 2 | 5 |
| English | 120 | (2) | 2 | 2 | 4 | French or German or Spanish | 94 or 75 or 111 | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | Drawing | 300 | (2) | 4 | 0 | 4 |
| | | | | | | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 27 | 51 | | | 18 | 30 | 21 | 51 |

SUMMER TERM: Land and Topographic Surveying, 165, 4 weeks (3)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S.A.Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Quant. Anal. | 401 | (3) | 9 | 0 | 9 | Quant. Anal. | 403 | (3) | 9 | 0 | 9 |
| Quant. An. Comf. | 402 | (1) | 1 | 1 | 2 | Quant. An. Conf. | 405 | (1) | 1 | 1 | 2 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound. | 325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| Mineralogy | 266 | (4) | 6 | 3 | 9 | Gen. Geology | 268 | (2) | 2 | 3 | 5 |
| B. P. Anal. | 267 | (1) | 3 | 0 | 3 | Geol. Lab. | 269 | (2) | 4 | 3 | 7 |
| Drawing | 300 | (1) | 3 | 0 | 3 | B. P. Anal. | 267 | (1) | 3 | 0 | 3 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 20 | 35 | 19 | 54 | | | 19 | 32 | 22 | 54 |

SUMMER TERM: Assaying, 413, 4 weeks (3)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mining Engr. | 301 | (4) | 4 | 4 | 8 | Mining Engr. | 303 | (4) | 4 | 4 | 8 |
| Ore Dr. & Lab. | 302 | (3) | 3 | 3 | 6 | Metallurgy | 247 | (3) | 3 | 4 | 7 |
| Mech. or Mat. | 167 | (4) | 4 | 8 | 12 | Heat Eng. | 222 | (3) | 3 | 6 | 9 |
| Heat Eng. | 221 | (3) | 3 | 6 | 9 | Hydraulics | 170 | (3) | 3 | 6 | 9 |
| Petrography | 276 | (2) | 3 | 2 | 5 | Hyd. Lab. | 171 | (1) | 3 | 0 | 3 |
| Econ. Geol. | 270 | (2) | 2 | 3 | 5 | Physiography | 274 | (2) | 2 | 2 | 4 |
| Forestry | 291 | (2) | 3 | 2 | 5 | Oil & Gas Tech. | 306 | (2) | 2 | 2 | 4 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | English | 127 | (2) | 2 | 4 | 6 |
| | | | | | | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 21 | 24 | 28 | 52 | | | 21 | 24 | 28 | 52 |

SUMMER TERM: Mine and Railroad Surveying, 304, 4 weeks (3)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mining Engr. | 305 | (3) | 3 | 3 | 6 | Mining Des. | 307 | (3) | 6 | 1 | 7 |
| N. F. Met. | 248 | (2) | 2 | 2 | 4 | Econ. Geol. | 271 | (4) | 5 | 5 | 10 |
| El. Chem. & Met. | 254 | (2) | 2 | 3 | 5 | N. F. Met. | 250 | (2) | 2 | 2 | 4 |
| Dyn. & Mot. | 354 | (2) | 2 | 4 | 6 | Alt. Cur. | 375 | (2) | 2 | 4 | 6 |
| Dyn. Lab. | 355 | (1) | 3 | 1 | 4 | Dyn. Lab. | 356 | (1) | 3 | 1 | 4 |
| Field Geol. | 275 | (3) | 7 | 3 | 10 | Geol. N. A. | 273 | (3) | 5 | 2 | 7 |
| Graph. Stat. | 178 | (2) | 4 | 2 | 6 | Engr. Lab. | 226 | (1) | 3 | 0 | 3 |
| Engr. Lab. | 220 | (1) | 3 | 0 | 3 | Mine Ad. | 305 | (1) | 1 | 2 | 3 |
| Bus. Engr. | 30a | (3) | 3 | 3 | 6 | Bus. Engr. | 30a | (3) | 3 | 3 | 6 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 20 | 31 | 21 | 52 | | | 21 | 32 | 20 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN ELECTRICAL ENGINEERING

The requirements for admission to the Curriculum in Electrical Engineering are given on page 20.

The object of this curriculum is to give a broad education in those general and scientific subjects which underlie all the branches of engineering, and to give special training in those technical and business subjects which experience shows are most essential in the equipment of the electrical engineer. In seeking to accomplish this object the Department puts chief emphasis upon mastery of principles and thoroughness in the analysis of problems.

The course includes a number of special studies in civil, mechanical, and metallurgical engineering, so that the graduate in Electrical Engineering is prepared not only to enter any of the branches of electrical engineering but also to deal with related problems in the other branches of engineering. The electrical engineering graduate of today finds that professional advancement often lies through commercial, managerial, or executive channels. As superintendent or manager of electric light, power, or railway properties he must be prepared to handle problems involving not merely material and technical details but human relations, touching workmen, capitalists, public utility commissioners, and the public. He must know something of the principles of accounting, economics, business law, and industrial management. A number of such studies have been introduced into the course.

The fundamental studies are given in the early part of the course and include mathematics, physics, chemistry, English, and a continuation of the modern language accepted for entrance. These subjects include the more essential features of a broad education, and they furnish a preparation for the more advanced scientific and technical training to follow.

At the close of the freshman year, students attend the R. O. T. C. encampment for six weeks and hand in a report on the work at the beginning of the sophomore year.

Work in applied electricity is pursued through the sophomore year in the study of Electric Distribution and Dynamos and Motors, with Dynamo Laboratory. The junior and senior years are devoted almost exclusively to advanced technical work.

During each of the vacations following the sophomore and junior years students are required to spend at least eight weeks in an electrical industrial plant or station and hand in a written report thereon at the beginning of the next college year.

The study of Electricity and Magnetism constitutes an introduction to the industrial applications of electricity. Electric Distribution makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance, and similar problems. The study also includes the installation and wiring of electrical machinery, systems of electrical distribution, and outside and interior wiring.

The study of Dynamos and Motors includes the construction, operation, and control of direct current generators and motors, with numerous illustrative problems. The study of dynamo electric machinery is resumed during the senior year in connection with the subjects of Electrical Design and Alternating Current Machinery.

Fundamental subjects in mechanical engineering are required in this curriculum. Machine Design is given throughout the sophomore year. Graphic Statics of Mechanisms deals with graphic methods of determining the forces acting at all points of a machine and with the efficiency of mechanisms. Heat Engines includes the study of steam boilers, thermodynamics, steam engines, turbines, and gas engines. Engineering Laboratory is given throughout the senior year.

Important studies in civil engineering are included in this course. Mechanics of Materials is concerned with the theory of beams, columns, and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory. Hydraulics, including laboratory practice, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes, and channels, naval hydromechanics, and hydraulic motors.

The study of General Metallurgy, Metallurgy of Iron and Steel, and Metallurgical Problems is given during the first term of the sophomore year. Lectures on Electrochemistry and Electrometallurgy are given during the senior year.

Advanced studies in electrical engineering follow the Electric Distribution, Dynamos and Motors, and Electricity and Magne-

tism of the sophomore year. Advanced Theory of Electricity and Magnetism is devoted to the theory of electrical units and measurements, ferromagnetism, electromagnetism, advanced theory of electrostatics, electric oscillations and waves, electron theory, and electrolysis. The accompanying laboratory work is devoted to precise electrical measurements and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents deals with the problems and methods of measurements which are peculiar to the modern practical applications of alternating currents and with the theory underlying the action of the important types of alternating current machinery and transmission lines. Alternating Current Machinery includes the study of the construction and operation of alternating current generators, motors, transformers, and other apparatus.

The subject of Electrical Engineering deals with the application of physical principles to the solution of problems relating to direct and alternating current circuits and apparatus.

Dynamo laboratory work, beginning in the second term of the sophomore year, is continued for five terms. Instruction is based on a laboratory manual or notes supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers, and other electrical apparatus. Written reports of all tests made, with curves plotted from the observations and discussion of results, are required. Throughout these courses the student is trained not only to perform the experimental work but also to plan and direct it.

Electrical Design, begun in the first term of the senior year, is pursued throughout the year. It includes the application of electric, magnetic, and mechanical principles to the design of various types of electrical apparatus. The instruction is given by recitations, problems, and drafting.

Electrical Engineering Seminary continues throughout the senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class room, and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign. One of the principal objects of the

Seminary work is to encourage the systematic reading of the current engineering journals.

Dynamo Testing, given by lectures and problems, treats of standard and special methods of making tests on dynamo machines, transformers, and other electrical apparatus.

Electric Stations takes up the location, design, and equipment of stations, the selection of suitable prime movers, generators, switchboards, and other apparatus. The cost of generating electric power and the various systems of determining rates receive consideration. Under Electric Traction are studied the construction, equipment, and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed, and the results of tests are analyzed.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line, and the receiving systems. Special attention is given to the design, construction, and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations and manufacturing establishments in Bethlehem and elsewhere. Central station tests are made, and reports are required.

Electric Communication deals with telephone and telegraph systems, with special emphasis on matters of radio telegraphy and telephony, including the theory and operation of vacuum tube circuits. The laboratory work given in connection with this course includes practical experiments and tests on radio apparatus of various types and the operation of sending and receiving sets.

Graduates of this curriculum recive the degree of Electrical Engineer (E.E.).

# THE CURRICULUM IN ELECTRICAL ENGINEERING

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal. Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (3) | 9 | 1 | 10 |
| Chem. Lab. | 391 or 393a | (2) | 6 | 0 | 6 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| French / or German / or Spanish | 94 / 75 / 111 | (3) | 3 | 6 | 9 | Phys. Measure | 322 | (1) | 3 | 2 | 5 |
| English | 120 | (2) | 2 | 2 | 4 | French / or German / or Spanish | 94 / 75 / 111 | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | English | 122 | (2) | 2 | 2 | 4 |
| | | | | | | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 27 | 51 | | | 18 | 28 | 23 | 51 |

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S. A. Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound. | 325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| Elec. Distribution. | 351 | (2) | 2 | 6 | 8 | Dyn. & Mot. | 352 | (3) | 3 | 6 | 9 |
| Dr. & El. M. Des. | 200 | (3) | 6 | 3 | 9 | Dyn. Lab. | 353 | (1) | 3 | 1 | 4 |
| Metallurgy | 247 | (3) | 3 | 4 | 7 | El. Mach. Des. | 203 | (3) | 3 | 6 | 9 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | Gr. St. of Mech. | 206 | (2) | 4 | 0 | 4 |
| | | | | | | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 28 | 52 | | | 19 | 26 | 28 | 54 |

SUMMER TERM: Work in Electrical Shops or Plant, with report, 376, 8 weeks (3)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Diff. Equations | 148 | (1) | 1 | 3 | 4 | Alt. Cur. | 359 | (2) | 2 | 4 | 6 |
| Anal. Mech. | 149 | (2) | 2 | 4 | 6 | Elec. Engr. | 360 | (3) | 3 | 6 | 9 |
| Alt. Currents | 357 | (3) | 3 | 4 | 7 | Dyn. Test. | 364 | (1) | 3 | 0 | 3 |
| Dyn. Lab. | 358 | (1) | 3 | 0 | 3 | Dyn. Lab. | 362 | (1) | 3 | 1 | 4 |
| Elec. Lab. | 328 | (1) | 3 | 0 | 3 | Elec. Lab. | 329 | (1) | 3 | 1 | 4 |
| Adv. Elec. & Mag. | 327 | (2) | 2 | 4 | 6 | Hydraulics | 170a | (2) | 2 | 4 | 6 |
| Mech. of Mat. | 167a | (3) | 3 | 6 | 9 | Hyd. Lab. | 171 | (1) | 3 | 0 | 3 |
| Mat. Test. Lab. | 168 | (1) | 3 | 0 | 3 | Heat Eng. | 222 | (3) | 3 | 6 | 9 |
| Heat Eng. | 221 | (3) | 3 | 6 | 9 | English | 127 | (3) | 3 | 3 | 6 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 18 | 25 | 27 | 52 | | | 18 | 27 | 25 | 52 |

SUMMER TERM: Work in Electrical Shops or Plant, with report, 376, 8 weeks (3)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alt. Cur. Mach. | 363 | (4) | 4 | 6 | 10 | Elec. Traction / or Elec Com. | 371 / 378 | (3) | 3 | 5 | 8 |
| Dyn. Testing | 365 | (1) | 1 | 1 | 2 | Elec. Power Tr. | 372 | (3) | 3 | 5 | 8 |
| Dyn. Lab. | 366 | (3) | 6 | 3 | 9 | Elec. Design | 370 | (2) | 2 | 3 | 5 |
| Elec. Design | 367 | (2) | 3 | 3 | 6 | Dyn. Lab. | 374 | (2) | 6 | 2 | 8 |
| Elec. Stations | 368 | (2) | 2 | 4 | 6 | Elec. Seminary | 373 | (1) | 2 | 1 | 3 |
| El. Chem. & Met. | 254 | (2) | 2 | 3 | 5 | Engr. Lab. | 226 | (1) | 3 | 0 | 3 |
| Engr. Lab. | 220 | (1) | 3 | 0 | 3 | Bus. Engr. | 30a | (3) | 3 | 3 | 6 |
| Elec. Seminary | 369 | (1) | 2 | 1 | 3 | Thesis | 377 | (3) | 8 | 1 | 9 |
| Bus. Engr. | 30a | (3) | 3 | 3 | 6 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | | | | | | |
| | | 20 | 28 | 24 | 52 | | | 19 | 32 | 20 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN CHEMISTRY

The requirements for admission to the Curriculum in Chemistry are given on page 20.

This curriculum, leading to the degree of Bachelor of Science in Chemistry, offers an education primarily in chemistry, with some training in related sciences. The modern conception of an education in chemistry includes a simultaneous thorough study of physics and mathematics. In addition to these so-called physical sciences, other studies, planned to develop and aid the thought-processes and culture of the student, are embodied in the course. It is believed by many practicing chemists and chemical engineers that an undergraduate course embracing a liberal allotment of study in the humanities is the best preparation for a successful career. Aside from preparation for the life of a professional chemist, the curriculum is well adapted for teachers of chemistry and as a course preliminary to the study of medicine.

This curriculum and the Curriculum in Chemical Engineering are both given under the direction of the Department of Chemistry, and it is readily possible to change from either course to the other at the end of either term of the Freshman year. The entrance subjects required are the same for both curricula (see page 20), and the tuition and laboratory costs are practically the same. Subjects with the same titles in the tabulated curricula (see pages 66 and 71) are given to students in both courses simultaneously and under the same teachers, and are equal in content. Details of chemistry subjects are described in the Curriculum in Chemical Engineering.

The study of English is carried through two full years of this curriculum, beginning in the freshman year and being resumed in the junior year, when the student has a more mature appreciation of literary values and of the necessity for clear and forceful expression in speech and writing. French and German receive considerably more attention in the Curriculum in Chemistry than in the Curriculum in Chemical Engineering, both as language tools for the working chemist and in their cultural aspects. Students who enter the University with French continue French through the freshman year, and take up German through the sopohomore and junior years. Those who offer German as an entrance subject continue German through the freshman and sopho-

more years and study French through the junior year. Students who offer Spanish for entrance take German through the freshman and sophomore years, and French through the junior year.

The course in Bacteriology of the senior year is given in the Department of Biology. A short course in Industrial Mineralogy accompanies the course in Assaying. Geology follows in the second term of the junior year.

Economics throughout the junior year and Modern European History through the senior year are given by the Department of History and Economics. The same department supervises the Summer Reading in Economics, embracing such subjects as the origins of industry and their relations to science, the economic import of inventions, industrial management, business law and custom, and contracts. The topics for Summer Reading are also correlated in the lectures under the heading Economics, mentioned above. It is believed that this course of reading and study under expert guidance will inculcate an appreciation of the profit and pleasure to be derived from a continued interest in history and economics.

Applications of the science of chemistry and the science of physics to industrial chemistry and to chemical engineering are carried out in the senior year under the courses called Industrial Chemistry and Industrial Chemistry Laboratory. These courses afford a thorough-going description of numerous manufacturing processes and include the necessary elements of chemical engineering. The industrial development of chemistry in the manufacture of metals is the subject of the various courses in Metallurgy and Electrometallurgy of the upper years. Here again the engineering features of many procedures are explained and receive critical study.

In order to acquaint the student with factory methods and personnel, a required summer term of work in factory or laboratory is set for the vacation following the junior year. Young men of exceptional ability and ambition are encouraged to enroll in subjects given in the University not listed in the Curriculum in Chemistry, subject to Faculty rules.

The foregoing curriculum will serve as an excellent preparation for graduate study; students who desire to go forward to the Master's Degree (M.S.) will find information in regard to the requirements for that degree on page 130 of this Register.

# THE CURRICULUM IN CHEMISTRY

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Chemistry | 394 | (1) | 1 | 1 | 2 |
| Chem. Lab. | 391 or 393a | (2) | 6 | 0 | 6 | Qual. Anal. | 395 | (3) | 9 | 0 | 9 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | Qual. An. Conf. | 396 | (1) | 1 | 2 | 3 |
| French or German. | 94 72 or 76 | (3) | 3 | 6 | 9 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| English | 120 | (2) | 2 | 2 | 4 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | Phys. Measure | 322 | (1) | 3 | 2 | 5 |
| | | | | | | French or German. | 94 72 or 76 | (3) | 3 | 5 | 8 |
| | | 18 | 24 | 27 | 51 | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | | | | | | | 18 | 28 | 23 | 51 |

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3); Summer reading in Economics, 30 (1)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S. A. Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Adv. Chem. | 398 | (3) | 3 | 3 | 6 | Adv. Chem. | 399 | (3) | 3 | 6 | 9 |
| Quant. Anal. | 400 | (3) | 9 | 0 | 9 | Quant. Anal. | 404 | (2) | 6 | 0 | 6 |
| Quant. An. Conf. | 402 | (1) | 1 | 2 | 3 | Quant. An. Conf. | 405 | (2) | 2 | 1 | 3 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound | 325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| German | 72, 76 or 78 | (3) | 3 | 5 | 8 | German | 72, 76 or 79 | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 20 | 29 | 25 | 54 | | | 20 | 27 | 27 | 54 |

SUMMER TERM: Assaying and Industrial Mineralogy, 4 weeks, 414 (3); Summer reading in Economics, 30 (1)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quant. Anal. | 406 | (2) | 6 | 0 | 6 | Org. Chem. | 410 | (4) | 4 | 5 | 9 |
| Quant. An. Conf. | 407 | (2) | 2 | 2 | 4 | Org. Chem. Lab. | 411 | (3) | 8 | 0 | 8 |
| Org. Chem. | 408 | (3) | 3 | 3 | 6 | I.&S.&Probs. | 245, 246 | (3) | 3 | 4 | 7 |
| Org. Chem. Lab. | 409 | (2) | 6 | 0 | 6 | Gen. Geol. | 268 | (2) | 2 | 3 | 5 |
| G.Met.&Probs. | 243,244 | (3) | 3 | 4 | 7 | Economics | 17 | (3) | 3 | 3 | 6 |
| Economics | 16 | (3) | 3 | 3 | 6 | French or German. | 90 76 or 79 | (3) | 3 | 5 | 8 |
| French or German. | 90 76 or 78 | (3) | 3 | 5 | 8 | English | 127 | (3) | 3 | 4 | 7 |
| English | 123 | (3) | 3 | 4 | 7 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | | | 22 | 28 | 24 | 52 |
| | | 22 | 31 | 21 | 52 | | | | | | |

SUMMER TERM: Work in Industrial Shop or Laboratory (3); Summer reading in Economics, 30 (1)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phys. Chem. | 419 | (3) | 3 | 3 | 6 | Phys. Chem. | 421 | (2) | 2 | 3 | 5 |
| Phys. Chem. Lab. | 420 | (1) | 3 | 0 | 3 | Phys. Chem. Lab. | 422 | (1) | 3 | 0 | 3 |
| Ind. Chem. Lab. | 412 | (3) | 9 | 2 | 11 | Ind. Chem. | 415 | (3) | 3 | 3 | 6 |
| Research Chem. | 423 | (3) | 3 | 6 | 9 | Research Lab. | 424 | (2) | 6 | 0 | 6 |
| N.F.Met.&Prob. | 248,249 | (3) | 3 | 4 | 7 | Ind. Chem. An. | 416 | (3) | 9 | 0 | 9 |
| Bacteriology | 296 | (2) | 3 | 3 | 6 | Ind. An. Conf. | 417 | (1) | 1 | 1 | 2 |
| El. Chem. | 426 | (1) | 1 | 1 | 2 | San. Chem. Lab. | 418 | (1) | 3 | 0 | 3 |
| History | 41 | (3) | 3 | 3 | 6 | N. F. Met. | 250 | (2) | 2 | 2 | 4 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | El. Met. | 253 | (1) | 1 | 2 | 3 |
| | | | | | | Hist. of Chem. | 425 | (1) | 1 | 1 | 2 |
| | | 20 | 30 | 22 | 52 | History | 42 | (3) | 3 | 3 | 6 |
| | | | | | | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | | | | | | | 21 | 36 | 15 | 51 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN CHEMICAL ENGINEERING

The requirements for admission to the Curriculum in Chemical Engineering are given on page 20.

This course of study is designed to prepare the student for the profession of chemical engineering in the construction, control, and management of manufacturing establishments which utilize the principles of chemistry and its allied arts. Aside from the primary requirement of chemistry, the modern development of the chemical engineer enforces a thorough knowledge of physics and mathematics, together with sound understanding of such fundamentals in mechanical and electrical engineering as will make him a discriminating research and operating engineer.

The following descriptions of subjects given in the Department of Chemistry apply as well to these subjects in the Curriculum in Chemistry. (See page 64.)

Elementary Chemistry, begun in the freshman year, in lectures with demonstrations, text-books, and recitations, is supplemented by experiments in the laboratory which develop manipulative skill and make careful observation habitual. An alternate course, less elementary in both class room and laboratory, is given to entering students who have had a considerable training in elementary chemistry. (See page 120.)

After this preliminary view of the elements of chemistry, there is developed that deeper insight into the changes of matter which is the particular province of general chemistry. In Advanced Chemistry of the first term in the sophomore year particularly attention is paid to the theories and modern concepts of chemistry, including solution, equilibrium and energy relations of molecules and of atoms, radio-activity, etc.,—a kind of junior physical chemistry of the greatest everyday importance in chemical engineering. Continued through the second term, this subject covers a moderately advanced study of chemical substances and their preparation and properties, together with an elementary consideration of phase rule and of such general applications as the relations underlying desirable properties in alloys, iron and steel, etc.

Organic Chemistry, taught during the entire junior year, familiarizes the student with the simple compounds of carbon, and acquaints him with the usefulness of this branch of chemistry in science, in the chemistry of animal and plant life, and

in the manufacture of such chemical products as dyes, drugs and medicines, oils, fats, waxes, and many others.

A course of lectures of two hours a week on Advanced Organic Chemistry is offered in the first half of the senior year to students who have shown marked ability in the Organic Chemistry and Organic Chemistry Laboratory of the junior year. This course is available for credit to graduate students who have completed a strong undergraduate course.

Introduction to the chemical analysis of substances is begun through Qualitative Analysis in the second term of the freshman year. This is a laboratory course, proceeding from the recognition of individual substances to the analysis of more complex solutions and solids. Lectures and recitations elucidate the facts and theories underlying analytical chemistry. The simpler mathematical relations of chemical processes are reviewed under Stoichiometry and are illustrated through many problems solved by the student. Quantitative Chemical Analysis by gravimetric, volumetric, and electrolytic methods follows through the sophomore year and the first term of the junior year, and takes up the analysis of ores, fuels, metallurgical products, commercial chemicals, and by-products. Frequent class room conferences accompany the laboratory work and consider the calculations involved and the scientific foundations of quantitative analysis. The analysis of industrial organic substances and of food-stuffs and drinking and boiler waters is placed in the final term of the senior year, when the student has a better foundation in increasing experience and a broader outlook on the important significance of Industrial Chemistry. At this stage, too, is placed the sampling and analysis of illuminating and heating gas, flue gases, and other special gases.

Fire-assaying of ores and of gold and silver bullion is taught in the summer term after the sophomore year when continuous attention throughout the day can be given to muffles and furnaces. The practice in Assaying is accompanied by an extensive consideration of the calculations and theories involved in the production of mixtures favorable for the work in hand. A course in Industrial Mineralogy is a part of this summer work, and leads to familiarity with about seventy-five minerals of commercial importance. These minerals are studied in their crystalline

forms, and also in the forms in which they often present themselves for final utilization by the chemical engineer.

The laboratory methods of Physical Chemistry and the systematic deeper study of the generalizations of chemistry learned in the sophomore year are reserved for the senior year under Physical Chemistry. Interrelations of the fundamentals of matter and energy are developed under such cognate headings as two-phase and multiphase systems, thermodynamics, gas reactions, mass action, electrochemistry, colloid chemistry, etc. Attention is given to the usefulness of Physical Chemistry in the solution of manufacturing problems in Chemical Engineering.

Intensive instruction in the application of factory methods in Chemical Engineering is likewise placed in the senior year and is grouped under Industrial Chemistry Laboratory and Industrial Chemistry. The processes reviewed are varied; such as transportation of gases, liquids, and solids; grinding and pulverizing; mechanical, hydraulic, and pneumatic separation; evaporation; distillation; filter pressing; centrifuging; autoclaving. The characteristics and adaptability of engineering materials used in apparatus and machines receive full discussion. Selected industries are investigated and explained. Familiarity with manufacture in scientific and economic aspects is promoted in a special laboratory fitted with industrial apparatus, the student finally submitting full working specifications for a plant designed for the preparation of some industrial product, together with estimates of the cost of raw material and cost of conversion into finished product. Lehigh University is fortunately situated in a district abounding in business enterprises which involve chemical engineering, and visits are made to these plants and to factories in the nearby cities of Philadelphia and New York.

In Research Chemistry in the senior year every student is required to solve a novel problem having a scientific basis and is expected to demonstrate some ability as an independent research worker. The research involves an exhaustive search for and study of the literature bearing on the subject in the University Library, including the patent literature. A short course in the History of Chemistry, with individual reading of significant records, co-ordinates the past progress of the science and leads to a nobler pride and an enhanced initiative in the profession which the graduate enters.

Metallurgy and related subjects are taken in the Department of Metallurgy. These give an extensive training in the prinicples and methods particularly applied to the recovery of metals from their ores, and the manufacture and properties of the industrial products, iron, steel, copper, zinc, lead, nickel, aluminum, mercury, gold, and silver. Drawing is under the direction of the Department of Mining Engineering. Instruction in mechanical engineering, so important to the chemical engineer, is given by the Mechanical Engineering Department. Mechanical Engineering is developed in Heat Engines of the junior year, and in the Engineering Laboratory of the summer term following the junior year, with a continuation of Engineering Laboratory in the senior year. Many of the problems and innovations of Chemical Engineering demand a more intimate knowledge of the principles and practice of electrical engineering than is given in the general course in Physics; this is provided for in the junior year under Dynamos and Motors and Alternating Currents, with their laboratory adjuncts, in the Department of Electrical Engineering. A comprehension of the scope and general methods of Geology and Bacteriology is attained in short courses in these subjects. Bacteriology is a lecture and laboratory course, and a working knowledge of bacteriological methods as applied to water and some industrial products is achieved. The study of German, a necessary tool in current chemistry, is carried by all students in the freshman year.

An approach to the affairs of men and the problems of business and civilization is made in courses given in the College of Business Administration. The full course of lectures in economics as given in the University is placed in the junior year. Related reading is specified as summer work, and an examination in this requirement is held on the first Saturday following the opening of the first term. The summer reading covers such topics as the origins of industry and their relation to science, industrial management, business law and custom, and contracts.

A scientific society is attached to the Department, with a membership of teachers and students, for the presentation of papers, discussion of current journals, and the entertainment of speakers of note in the profession of chemical engineering.

The degree granted on completion of the curriculum is Chemical Engineer (Ch.E.).

# THE CURRICULUM IN CHEMICAL ENGINEERING

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry | 390 or 393 | (2) | 2 | 4 | 6 | Chemistry | 394 | (1) | 1 | 1 | 2 |
| Chem. Lab. | 391 or 393a | (2) | 6 | 0 | 6 | Qual. Anal. | 395 | (3) | 9 | 0 | 9 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | Qual. An. Conf. | 396 | (1) | 1 | 2 | 3 |
| German | 72 or 76 | (3) | 3 | 6 | 9 | Stoichiometry | 397 | (1) | 1 | 1 | 2 |
| English | 120 | (2) | 2 | 2 | 4 | El. Mechanics | 321 | (3) | 3 | 4 | 7 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | Phys. Measure | 322 | (1) | 3 | 2 | 5 |
| | | | | | | German | 72 or 76 | (3) | 3 | 5 | 8 |
| | | 18 | 24 | 27 | 51 | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | | | | | | | 18 | 28 | 23 | 51 |

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3); Summer reading in Economics, 30 (1)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S. A. Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Adv. Chem. | 398 | (3) | 3 | 3 | 6 | Adv. Chem. | 399 | (3) | 3 | 6 | 9 |
| Quant. Anal. | 400 | (3) | 9 | 0 | 9 | Quant. Anal. | 404 | (3) | 9 | 0 | 9 |
| Quant. An. Con. | 402 | (2) | 2 | 2 | 4 | Quant. An. Conf. | 405 | (2) | 2 | 3 | 5 |
| Elec. & Mag. | 323 | (3) | 3 | 4 | 7 | Light & Sound | 325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. | 324 | (1) | 2 | 1 | 3 | L., E. & M. Lab. | 326 | (1) | 2 | 1 | 3 |
| Drawing | 300 | (1) | 3 | 0 | 3 | Drawing | 300 | (1) | 3 | 0 | 3 |
| English or German | 123 / 73 | (2) | 2 | 2 | 4 | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | | | | | | |
| | | 21 | 32 | 22 | 54 | | | 19 | 30 | 24 | 54 |

SUMMER TERM: Assaying and Industrial Mineralogy, 4 weeks, 414 (3); Summer reading in Economics, 30 (1)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quant. Anal. | 406 | (2) | 6 | 0 | 6 | Org. Chem. | 410 | (4) | 4 | 5 | 9 |
| Quant. An. Conf. | 407 | (1) | 1 | 1 | 2 | Org. Chem. Lab. | 411 | (3) | 9 | 0 | 9 |
| Org. Chem. | 408 | (3) | 3 | 2 | 5 | I.&S.&Probs. | 245, 246 | (3) | 3 | 4 | 7 |
| Org. Chem. Lab. | 409 | (2) | 5 | 0 | 5 | Alt. Cur. | 375 | (2) | 2 | 4 | 6 |
| Dyn. & Mot. | 354 | (2) | 2 | 4 | 6 | Dyn. Lab. | 356 | (1) | 3 | 1 | 4 |
| Dyn. Lab. | 355 | (1) | 3 | 1 | 4 | Heat Eng. | 224 | (3) | 3 | 6 | 9 |
| G.Met.&Probs. | 243, 244 | (3) | 3 | 4 | 7 | Economics | 17 | (3) | 3 | 3 | 6 |
| Heat Eng. | 223 | (3) | 3 | 6 | 9 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| Economics | 16 | (3) | 3 | 3 | 6 | | | | | | |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | | | | | | |
| | | 21 | 31 | 21 | 52 | | | 20 | 29 | 23 | 52 |

SUMMER TERM: Engineering Laboratory, 4 weeks, 225 (3); Summer reading in Economics, 30 (1)

## SENIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phys. Chem. | 419 | (3) | 3 | 3 | 6 | Phys. Chem. | 421 | (2) | 2 | 3 | 5 |
| Phys. Chem. Lab. | 420 | (1) | 3 | 0 | 3 | Phys. Chem. Lab. | 422 | (1) | 3 | 0 | 3 |
| Ind. Chem. Lab. | 412 | (3) | 9 | 2 | 11 | Ind. Chem. | 415 | (3) | 3 | 3 | 6 |
| Research Chem. | 423 | (2) | 2 | 4 | 6 | Research Lab. | 424 | (2) | 5 | 0 | 5 |
| N.F.Met.&Prob. | 248, 249 | (3) | 3 | 4 | 7 | Ind. Chem. An. | 416 | (3) | 9 | 0 | 9 |
| Engr. Lab. | 220 | (1) | 3 | 0 | 3 | Ind. An. Conf. | 417 | (1) | 1 | 1 | 2 |
| Bacteriology | 296 | (2) | 3 | 3 | 6 | San. Chem. Lab. | 418 | (1) | 3 | 0 | 3 |
| El. Chem. | 426 | (1) | 1 | 1 | 2 | Hist. of Chem. | 425 | (1) | 1 | 1 | 2 |
| El. Chem. Lab. | 427 | (1) | 3 | 0 | 3 | N. F. Met. | 250 | (2) | 2 | 2 | 4 |
| English | 137 | (1) | 2 | 0 | 2 | El. Met. | 253 | (1) | 1 | 2 | 3 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Engr. Lab. | 226 | (1) | 3 | 0 | 3 |
| | | | | | | Gen. Geol. | 268 | (2) | 2 | 3 | 5 |
| | | 19 | 34 | 17 | 51 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | | | | | | | 21 | 37 | 15 | 52 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN MARINE ENINEERING AND TRANSPORTATION

The requirements for admission to the Curriculum in Marine Engineering and Transportation are given on page 20.

The purpose of this curriculum is to prepare men to engage in the design, construction, and operation of ships, and to enter the field of marine transportation. The curriculum is a combination of engineering and economics preceded by the fundamental subjects common to engineering courses: chemistry, modern languages, physics, and mathematics. Combining, as it does, engineering training with studies in economics and business administration, such a course offers great advantages. It has been planned to develop a class of men who, in addition to a knowledge of conditions governing ocean and inland water transportation, will have a command of the technical, economic, and financial problems of ship design, construction, and operation.

The first and second years are devoted largely to physics, modern languages, chemistry, engineering drawing, and mathematics, all of which afford necessary preparation for the technical work in later years.

The second-year schedule, although largely concerned with science, embraces some preliminary work in engineering and economics. There is a detailed study of ship construction, including lectures and class room work covering the main features of ship construction, and also work in the drawing room where drawings of ship construction are worked up by the student. In the second term the student fairs up a set of ship's lines. Both the transverse and longitudinal types of construction are given full treatment in this course.

The junior year schedule includes these fundamental engineering subjects: Mechanics of Materials, Hydraulics, Naval Architecture, Heat Engineering, Marine Engineering, and Astronomy and Navigation. Class room work in most of the subjects is supplemented by exercises in the laboratories. In the first term of the third year a study is made of the theory of heat engineering and thermodynamics. The course is followed in the second term by a study of marine engineering with special emphasis on the types of propelling machinery, the layout of the marine power plant, and economic problems in marine engineering.

In the senior year the student takes up Ship Design, Marine Engines, Turbines, Diesel Engines, Structural Steel Design, Electrical Engineering, Economics, and Marine Transportation. For those who desire further work in foreign languages, an opportunity is given in the senior year for the study of Spanish.

An important feature of the Lehigh Curriculum in Marine Engineering and Transportation is the large amount of time devoted to the study of economics and allied subjects. To arouse the student's interest and to fit him for work in marine transportation and foreign trade, instruction in Economics and Economic Geography is given in the sophomore year, followed by Accounting and Finance in the junior year, and by Foreign Trade, Marine Insurance, and Admiralty Law in the senior year.

Surveying is given during four weeks of the summer term immediately following the close of the freshman year.

Students are required to do summer work in shipyards and on shipboard, and the department co-operates in finding positions for them. The summer following the sophomore year is spent in a shipyard. This brings the student into direct contact with practical ship construction and shipyard practices, so that he unconsciously acquires a knowledge of the proportions and dimensions of engineering structures. The summer following the junior year is spent at sea so that the student may observe the action of a ship at sea and study the operation of the ship's power plant.

Graduates of this course receive the degree of Marine Engineer (Mar.E.).

# THE CURRICULUM IN MARINE ENGINEERING AND TRANSPORTATION

## FRESHMAN YEAR

| FIRST TERM N | C | R | P | T | SECOND TERM N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra ....143 | (4) | 4 | 8 | 12 | F. Anal Geom. ..145 | (3) | 3 | 6 | 9 |
| Chemistry .390 or 393 | (2) | 2 | 4 | 6 | Qual. Anal. .....395 | (2) | 6 | 1 | 7 |
| Chem. Lab. 391or393a | (2) | 6 | 0 | 6 | Stoichiometry ...397 | (1) | 1 | 1 | 2 |
| El. Mechanics ...320 | (3) | 3 | 5 | 8 | El. Mechanics ...321 | (3) | 3 | 4 | 7 |
| French ..... 94 | | | | | Phys. Measure ..322 | (1) | 3 | 2 | 5 |
| or German .... 75 | (3) | 3 | 6 | 9 | French ..... 94 | | | | |
| or Spanish ....111 | | | | | or German .... 75 | (3) | 3 | 5 | 8 |
| English .....120 | (2) | 2 | 2 | 4 | or Spanish ....111 | | | | |
| M.S. & P.E..470, 500 | (2) | 4 | 2 | 6 | English .....122 | (2) | 2 | 2 | 4 |
| | | | | | Drawing .....162 | (1) | 3 | 0 | 3 |
| | | | | | M.S. & P.E..470, 500 | (2) | 4 | 2 | 6 |
| | 18 | 24 | 27 | 51 | | 18 | 28 | 23 | 51 |

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (3)

## SOPHOMORE YEAR

| FIRST TERM N | C | R | P | T | SECOND TERM N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|
| Cal. & S. A. Geom.146 | (4) | 4 | 8 | 12 | Int. Calculus ....147 | (4) | 4 | 8 | 12 |
| Elec. & Mag. ....323 | (3) | 3 | 4 | 7 | Light & Sound...325 | (3) | 3 | 4 | 7 |
| M. & H. Lab. ...324 | (1) | 2 | 1 | 3 | L., E. & M. Lab..326 | (1) | 2 | 1 | 3 |
| Metallurgy .....247 | (3) | 3 | 4 | 7 | Econ. Geog. ..... 35 | (3) | 3 | 6 | 9 |
| Engr. Drawing ..163 | (3) | 7 | 1 | 8 | Ship Constr. ....451 | (4) | 9 | 2 | 11 |
| Ship Constr. ....450 | (2) | 4 | 1 | 5 | Economics ..... 17 | (3) | 3 | 3 | 6 |
| Economics ..... 16 | (3) | 3 | 3 | 6 | M.S. & P.E..471, 500 | (2) | 4 | 2 | 6 |
| M.S. & P.E..471, 500 | (2) | 4 | 2 | 6 | | | | | |
| | 21 | 30 | 24 | 54 | | 20 | 28 | 26 | 54 |

SUMMER TERM: Work in Shipyard on Hull Construction, with report, 458, 8 weeks (3)

## JUNIOR YEAR

| FIRST TERM N | C | R | P | T | SECOND TERM N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|
| Mech. of Mat. ....167 | (4) | 4 | 8 | 12 | Hydraulics .....170 | (3) | 3 | 6 | 9 |
| Mat. Test. Lab...168 | (1) | 3 | 0 | 3 | Hyd. Lab. .....171 | (3) | 3 | 0 | 3 |
| Naval Arch. ....452 | (3) | 3 | 5 | 8 | Naval Arch. ....453 | (4) | 4 | 8 | 12 |
| Astronomy .....150 | (3) | 3 | 6 | 9 | Navigation .....153 | (2) | 2 | 6 | 8 |
| Heat Engr. .....218 | (3) | 3 | 6 | 9 | Marine Engr. ....454 | (4) | 4 | 8 | 12 |
| Accounting ..... 20 | (3) | 3 | 6 | 9 | Finance ..... 18 | (2) | 2 | 4 | 6 |
| Physical Ed. ....500 | (1) | 2 | 0 | 2 | Physical Ed. ....500 | (1) | 2 | 0 | 2 |
| | 18 | 21 | 31 | 52 | | 17 | 20 | 32 | 52 |

SUMMER TERM: At Sea, with report, 458, 8 weeks (3)

## SENIOR YEAR

| FIRST TERM N | C | R | P | T | SECOND TERM N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|
| Ship Design ....455 | (3) | 6 | 3 | 9 | Ship Design .....456 | (3) | 6 | 3 | 9 |
| Marine Engr. ....460 | (3) | 3 | 6 | 9 | Ship Operation ..459 | (2) | 2 | 4 | 6 |
| Str. Steel Des. ..176 | (3) | 3 | 6 | 9 | Engr. Lab. .....226 | (1) | 3 | 0 | 3 |
| Engr. Lab. .....220 | (1) | 3 | 0 | 3 | Mech. Engr. ....219 | (2) | 2 | 4 | 6 |
| Term. Facilities..457 | (2) | 2 | 4 | 6 | Foreign Trade ... 29 | (3) | 3 | 6 | 9 |
| Admiralty Law .. 32a | (2) | 2 | 4 | 6 | English .....127 | | | | |
| or Spanish ....110 | (3) | 3 | 3 | 6 | or Spanish ....110 | (3) | 3 | 3 | 6 |
| Dyn. & Mot. .....354 | (2) | 2 | 4 | 6 | Alt. Cur. .....375 | (2) | 2 | 4 | 6 |
| Dyn. Lab. .....355 | (1) | 3 | 1 | 4 | Dyn. Lab. .....356 | (1) | 3 | 1 | 4 |
| Physical Ed. ....500 | (1) | 2 | 0 | 2 | Physical Ed. ....500 | (1) | 2 | 0 | 2 |
| | 18 | 26 | 28 | 54 | | 18 | 26 | 25 | 51 |

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

## THE CURRICULUM IN ENGINEERING PHYSICS

The recent growth and expansion of industrial research laboratories, in which methods and apparatus are investigated and developed for engineering application, has caused a large demand for young men capable of attacking the problems arising in these laboratories. The aim of the Curriculum in Engineering Physics is to provide the training necessary for this kind of work; it also provides a training which will prepare young men eventually to follow a career of pure science.

To accomplish this aim, the curriculum includes a thorough grounding in physics, both experimental and theoretical; a comprehensive course in mathematics; elective courses in purely engineering subjects; and elective courses of a broadening and cultural nature, which are felt to be important in the education of this type of engineer.

The freshman year is largely devoted to mathematics, mechanics, chemistry, and English, the fundamentals of all engineering. Modern language and engineering drawing are also included, as is a course in Physical Measurements, in which the student learns the technique of handling simple apparatus, curve plotting, and the orderly recording of data.

During the summer the students may attend the R. O. T. C. Summer Encampment for six weeks.

In the sophomore year, mathematics is continued through Integral Calculus. Elementary Physics is taught throughout the year by recitations, lectures, and laboratory work. As an introduction to modern physics, a course of lectures and recitations, giving a non-mathematical account of the modern views concerning such subjects as the nature of matter, radio-activity, X-rays, etc., is included in both terms.

The course in drawing given in the first term provides an introduction to the descriptive geometry of projections, intersections, and developments. The second term contains a course in Dynamos and Motors accompanied by laboratory exercises, introducing the student to the engineering viewpoint in electricity. Two credit hours of electives in subjects other than physics are offered.

During the summer the student must spend at least eight weeks as an employee in an industrial research laboratory or at the Bureau of Standards, and he must prepare and hand in a report on this work at the beginning of the junior year.

In the junior year, a course is given which serves as an introduction to Mathematical Physics and is intended to show the application of Advanced Calculus and Differential Equations to Physics. Topics are selected from Mechanics, Thermodynamics and the Kinetic Theory of Gases, the Wave Theory of Light, and the Theory of Electricity and Magnetism. A laboratory course of a more advanced nature than those given in the freshman and sophomore years runs parallel throughout the year to the above selected topics. Mathematics is continued by an introductory course, including Vector Analysis, Partial Differential Equations, Fourier's Series, and Spherical and Zonal Harmonics. Five credit hours of electives in electrical, mechanical, or chemical engineering subjects and three credit hours in courses in broadening and cultural subjects are taken throughout the year.

Summer work for eight weeks at an industrial research laboratory or at the Bureau of Standards is required, and the report on this work is handed in at the beginning of the senior year.

In the senior year, eight credit hours throughout the year are devoted to Advanced Physics, including the Advanced Theory of Electricity and Magnetism, Electric Oscillations, Electric Waves, and High Frequency Measurements; Physical Optics and Spectroscopy, including theoretical and experimental study of Diffraction, Dispersion and Interference, Polarization and Modern Spectroscopy, Electron Discharge through Gases, including the properties of Electrons, Gaseous Ions, Thermionic and Photoelectric Measurements; Heat, Thermodynamics, and Heat Radiations. All of these topics are accompanied by advanced laboratory work, the students being assigned laboratory problems of such nature as to train them in the methods of original research.

A thesis is prepared during the senior year to supplement and amplify one of the four courses in Physics offered in that year. The purpose of the thesis is to stimulate independence and originality and to instruct the students in the general method of attacking a laboratory problem and of looking up scientific literature. In order that a student may become familiar with the method of making laboratory tests in industrial engineering, a course in Engineering Laboratory is given throughout the year. The cultural and broadening studies offered in the junior year are continued as electives in both terms.

Graduates of this course receive the degree of Bachelor of Science (B.S.) in Engineering Physics.

# CURRICULUM IN ENGINEERING PHYSICS

## FRESHMAN YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adv. Algebra | 143 | (4) | 4 | 8 | 12 | P. Anal. Geom. | 145 | (3) | 3 | 6 | 9 |
| Chemistry .390 or 393 | | (2) | 2 | 4 | 6 | Qual. Anal. | 395 | (3) | 9 | 1 | 10 |
| Chem. Lab. 390 or 393a | | (2) | 6 | 0 | 6 | El. Mech. | 321 | (3) | 3 | 4 | 7 |
| El. Mechanics | 320 | (3) | 3 | 5 | 8 | Phys. Meas. | 322 | (1) | 3 | 0 | 3 |
| French 94 or German 75 | | (3) | 3 | 6 | 9 | Drawing | 162 | (1) | 3 | 0 | 3 |
| English | 120 | (2) | 2 | 2 | 4 | French 94 or German 75 | | (3) | 3 | 5 | 8 |
| M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 | English | 122 | (2) | 2 | 2 | 4 |
| | | | | | | M.S. & P.E. | 470, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 24 | 27 | 51 | | | 18 | 30 | 20 | 50 |

SUMMER TERM: R. O. T. C. Camp, 470a, 6 weeks (3)

## SOPHOMORE YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal. & S.A. Geom. | 146 | (4) | 4 | 8 | 12 | Int. Calculus | 147 | (4) | 4 | 8 | 12 |
| Physics | 323 | (3) | 3 | 4 | 7 | Physics | 325 | (3) | 3 | 4 | 7 |
| Physics | 332 | (2) | 2 | 4 | 6 | Physics | 332 | (2) | 2 | 4 | 6 |
| Phys. Lab. | 324 | (1) | 3 | 1 | 4 | Phys. Lab. | 326 | (1) | 3 | 1 | 4 |
| Drawing | 163 | (3) | 7 | 1 | 8 | Dyn. & Mot. | 354 | (2) | 2 | 4 | 6 |
| French 100 or German 78 | | (3) | 3 | 5 | 8 | Dyn. Lab. | 355 | (1) | 3 | 1 | 4 |
| M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 | Electives | | (2) | 2 | 4 | 6 |
| | | | | | | M.S. & P.E. | 471, 500 | (2) | 4 | 2 | 6 |
| | | 18 | 26 | 25 | 51 | | | 17 | 23 | 28 | 51 |

SUMMER TERM: Work in Industrial Research Laboratory or the Bureau of Standards, with report, 8 weeks (3)

## JUNIOR YEAR

| FIRST TERM | N | C | R | P | T | SECOND TERM | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mathematics | | (3) | 3 | 6 | 9 | Mathematics | | (3) | 3 | 6 | 9 |
| Physics | 333 | (3) | 3 | 6 | 9 | Physics | 333 | (3) | 3 | 6 | 9 |
| Physics | 334 | (2) | 6 | 0 | 6 | Physics | 334 | (2) | 6 | 0 | 6 |
| Engr. Elec. | | (5) | 5 | 10 | 15 | Engr. Elec. | | (5) | 5 | 10 | 15 |
| Electives | | (3) | 3 | 6 | 9 | Electives | | (3) | 3 | 6 | 9 |
| Physical Ed. | 500 | (1) | 2 | 0 | 2 | Physical Ed. | 500 | (1) | 2 | 0 | 2 |
| | | 17 | 22 | 28 | 50 | | | 17 | 22 | 28 | 50 |

SUMMER TERM: Work in Industrial Research Laboratory or the Bureau of Standards, with report, 8 weeks (3)

## SENIOR YEAR

| N | C | R | P | T | N | C | R | P | T |
|---|---|---|---|---|---|---|---|---|---|
| Physics 335 | (3) | 3 | 6 | 9 | Physics 339 | (3) | 3 | 6 | 9 |
| Physics Lab. 336 | (1) | 3 | 0 | 3 | Physics Lab. 340 | (1) | 3 | 0 | 3 |
| Physics 337 | (3) | 3 | 6 | 9 | Physics 341 | (3) | 3 | 6 | 9 |
| Physics Lab. 338 | (1) | 3 | 0 | 3 | Physics Lab. 342 | (1) | 3 | 0 | 3 |
| Engr. Lab. 213 | (1) | 3 | 0 | 3 | Engr. Lab. 217 | (1) | 3 | 0 | 3 |
| Thesis 443 | (4) | 4 | 8 | 12 | Thesis 443 | (4) | 4 | 8 | 12 |
| Electives | (3) | 3 | 6 | 9 | Electives | (3) | 3 | 6 | 9 |
| Physical Ed. 500 | (1) | 2 | 0 | 2 | Physical Ed. 500 | (1) | 2 | 0 | 2 |
| | 17 | 24 | 26 | 50 | | 17 | 22 | 26 | 50 |

In choosing electives the head of the curriculum should be consulted; all selections must be approved by him.

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

# DESCRIPTION OF UNDERGRADUATE COURSES

Following is a complete list of the undergraduate courses offered by the University. The number of exercises a week in each subject is indicated by the figures in parenthesis. Three hours of drawing, three of work in the laboratory, or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

## PSYCHOLOGY

PROFESSOR HUGHES, MR. WEINLAND

1. General Psychology. Seashore. For B.A. students. Recitations and demonstrations. First term (3).

2. Educational Psychology. Individual differences; analysis of mental traits; learning and memory; how to study; transfer of training; motivation and character building; the psychology of specific activities, as of speech, writing, arithmetic, sport, art, religion. Assigned readings; quantitative studies; lectures and discussions; laboratory. For B.A. students. *Prerequisite:* 1. Second term (3).

3. Advanced Educational Psychology. Practice in administering individual and group tests. Study of administrative applications. Study of classical investigations in the general field covered by course 2, with some first-hand investigation or experiment. *Prerequisite:* 2. First term (3).

4. Elements of Clinical Psychology. Primarily for seniors in the pre-medical curriculum. Abnormalities and diseases of the mind. The psychology of the emotions and of temperament. Individual studies, with use of intelligence and temperament tests. Psychotherapy. Mental Hygiene. Watson's *Psychology from the Standpoint of a Behaviorist.* Current magazine literature. Excursions to hospitals and clinics. *Prerequisite:* 1 or 2. Second term (3).

5. Principles of Psychology. For B.S. students. Seashore. Recitations and demonstrations; laboratory. First term (3).

6. Economic Psychology. For B.S. students. Problems of personnel, of motivation in industry, and of industrial training. Lectures, assigned readings, laboratory. *Prerequisite:* 1 or 5. Second term (3).

7. Experimental Psychology. A course for seniors who wish to conduct individual studies in some field of psychological experiment. *Prerequisite:* 2 or 6. First or second term (1).

7a. Psychology for Engineers. *Applied Psychology,* Hollingworth and Poffenberger. First or second term (2).

## PHILOSOPHY

PROFESSOR HUGHES

8. History of Philosophy. Ancient. A careful study of Plato's *Republic.* Lectures and readings in the great philosophical tradition. First term (3).

9. History of Philosophy. Modern. The rise of modern science, contrasted with Greek thought. Spinoza's *Ethics.* Tendencies in modern thought. Perry's *Present Conflict of Ideals.* Second term (3).

10. Scientific Method. Jones' *Logic;* Libby's *Outline of the History of Science.* Second term (3).

10a. Ethics. This course endeavors to present the development of the moral ideal of the race through the influence of great personalities. Lectures and discussions; papers. First and second terms (1).

## EDUCATION

ASSISTANT PROFESSOR DROWN, PROFESSOR HUGHES

In this connection the student should study the statement on pages 34 to 36 concerning preparation for teaching.

11. Introduction to Teaching. Adjusting pupils' school and social interests. Introduction of pupil to effective methods of study. Subject matter and method related to technique and routine. Dewey, Earhart, Holley, First term (3).

12. History of Education. The advance of civilization and culture and the parallel progress of educational theory and practice. (1) Evolution of subject matter; the liberal arts, letters, science, social sciences, the vernacular, vocational and fine arts. (2) Evolution of educational institutions; the university, the college, the secondary and elementary types, the rise of national and state school systems. (3) Educational leaders; how they reflected their times, and their contributions to educational philosophy and practice. Cubberley's *History of Education* and Readings. Second term (3).

13. Principles of High School Teaching. Character and qualifications essential to the high school teacher. The character of the high school student. Types of class exercises in the high school. Essential factors and devices of high school methods; lesson-planning and the assignment; the question; note-books and reports; reviews and examinations; the laboratory; experimentation and demonstration; the library and source material; problems and projects. Exercises in lesson planning, readings, and observations. First term (3).

14. School Efficiency. State and local school systems. Organization of the school. Organization and routine of the class room; management, discipline, supplies, forms, reports; markings, grading, testing, promotion. The external and administrative aspects of teaching. Second term (3).

15. Problems of Secondary Education. Secondary education; its historical and comparative aspects; study of German, French, English, and American secondary schools. The social background of American secondary education. The aims, values, and functions of secondary education; analysis of each of the secondary subjects in terms of the same. The personnel of the secondary school. Problems arising out of adolescence; problems arising out of individual differences; problems arising out of economic and social conditions. Articulation with elementary and higher education; the junior high school; the junior college; accrediting and examination systems. Programs of studies; required and elective subjects. Administrative problems. Extra-curricular activities; the teaching staff; the plant and its equipment; costs and finance. Second term (3).

15a. Practice Teaching. This work is for the most part carried on in the Bethlehem High Schools. The Junior and Senior High Schools of Allentown and Easton also are observed. The work is divided into three approximately equal parts: (1) Observation and report with conference; (2) apprentice work, involving participation in the routine work of the class, conduct of study periods, and correcting of papers; (3) actual conduct of class work, after careful study of lesson plans, followed by systematic criticism by the assisting teacher and by the professors of the department. For students in education in the junior and senior years. (2-6.)

Special Method. See courses 54, 83, 93, 339.

Educational Psychology. See courses 2 and 3.

## BUSINESS ADMINISTRATION, HISTORY, AND POLITICAL SCIENCE

PROFESSOR CAROTHERS, ASSOCIATE PROFESSOR BICKLEY, ASSISTANT PROFESSORS CURTIS AND BROWN, MR. CUSTARD

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3).

17. Economics. Practical economic problems; taxation, transportation, finance, labor, trusts, and monopolies. Second term (3).

18. Business Finance. A study of the financial needs of the different forms of industrial organization, including individual proprietorship, partnership, corporation, and holding company, together with various means of meeting these needs. Second term (2).

18a. Corporation Finance. A study of the means of financing a corporation, including the sale of commercial paper, common and preferred stock, debenture and mortgage bonds, promotion of new corporations, underwriting, re-organization, and receivership. First and second terms (3).

19. Public Finance. Government expenditures and their relation to the functions of government and to social, political, and industrial conditions; formulation of budgets; nature and employment of public credit; origin and growth of public debts; revenues from various sources, with reference both to the theory and to the practice of various nations. First and second terms (3).

20. Accounting Theory and Practice. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problem involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. The economic aspects of accounting are emphasized. First and second terms (3).

21. Corporation Accounting. (Elective, junior year.) The application of accounting principles to corporations; corporation accounts and records. The voucher system; construction

and analysis of corporate statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work is given during the second term. The problems are selected largely from examinations for Certified Public Accountants. First and second terms (3).

21a. Auditing. (Elective, senior year.) Procedure in conducting an audit; detection of errors and defalcations; financial conditions of a business as revealed by the accounts and other sources of information. The social responsibilities of auditing. First term (3).

21b. Cost Accounting. (Elective, senior year.) The various systems of manufacturing accounts for different types of manufacturing enterprises; choice of methods to meet peculiar needs; installing cost systems; forms and records; manufacturing accounts as an aid to and as a check on production efficiency; preparation of reports for executives. Second term (3).

22. Transportation. Development of transportation facilities. Consideration, from the administrative viewpoint, of railways and waterways as factors in the social and industrial development of the United States. The organization of railways, considering charters and franchises, capital stock, directors and stockholders. The administration and operation of railways, considering the activities of the various departments,—transportation, traffic, executive, financial, and legal. Relations between railroads and their employees. Public regulation and control of transportation facilities. First and second terms (2).

23. Labor Legislation and Administration. Labor problems confronting the employer and the more successful methods of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employer's Liability and Workmen's Compensation Acts. First and second terms (3).

24. Development of Economic Thought. The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English*

*Thought* and the works on political economy of Keynes, Cohn, and Ingram. First and second terms (3).

25. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the securities of corporations as investments. First and second terms (3).

26. Statistics. Statistical method and applied statistics. Practice in the handling and especially in the interpretation of statistics. First and second terms (3).

27. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states. The currency and currency problems of this country. Special emphasis is laid upon the Federal Reserve Act, foreign exchange, and factors affecting the money market. First and second term (3).

28. Foreign Exchange. Foreign monies and exchange ratios, financing of exports and imports, factors determining exchange rates, statistical studies in the field of foreign exchange, instruments and forms used in foreign trade. First term (3).

29. Foreign Trade and Marine Insurance. An historical and statistical study of international trade; the organization of steamship lines; combines, export associations, and rate agreements; line and charter traffic and trade routes. A study of steamship ports and the influence of the hinterland with special attention to the relations of inland waterways and railway transportation to ocean commerce. Also a study of the special methods necessary for successful trading with undeveloped but progressing nations. Principles of insurance and the peculiarities of marine risks and policies. Second term (3).

30. Summer Reading in Economics. Assignments for summer of 1924. Freshman: Resources. Van Hise's *The Conservation of Natural Resources.* Sophomore: Industrial Society. Marshall and Lyons' *Our Economic Organization.* Junior: Industrial Administration. Webb's *The Works Manager Today;* Gantt's *Organizing for Work;* Tead's *Instincts in Industry.* (1).

30a. Business Engineering. The organization and financing of business associations, economics, accounting, finance. For senior students in engineering. First and second terms (3).

31. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts. First term (2).

32. Elements of Business Law. Principal and agent; master and servant; sale of goods; negotiable instruments; business associations; partnerships and corporations. Second term (2).

32a. Admiralty and Maritime Law. Study of the principles and rules which regulate the conduct, the business, and the property in matters of admiralty and maritime character. First term (2).

33. Constitutional Law. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. First and second terms (3).

34. International Law. The development of international law; its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war. The Law of Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. First and second terms (3).

35. Economic Geography of North and South America. Physical features, climate, and resources of the Western Hemisphere; their influence upon the economic, political, and social institutions. The present and prospective commercial relations of the United States with Mexico and Central and South America. First and second terms (3).

36. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern Hemisphere; their influence upon the economic, political, and social institutions. Study of Great Britain, Germany, Russia, China, Japan, India, and the Philippine Islands; the present and prospective commercial relations of these countries with the United States. First and second terms (3).

38. Industrial History. The evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany, and the United States. First and second terms (4).

39. The Political and Constitutional History of the U. S. prior to 1860. The era of constitution-making, state and federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising with internal improvements, the tariff, the bank, and slavery. First term (3).

40. Political and Constitutional History of the U. S. since 1860. Continuation of Course 39. Second term (3).

41. European History. The formation of the modern European nationalities. The rise of the universities. The revival of learning. The Reformation. The relations of Europe and America. First term (3).

42. European History. The history of modern Europe. The development of Great Britain. The French Revolution and the history of the Nineteenth Century. Second term (3).

44. Thesis. Each candidate for the degree of B.S. in Business Administration is required to present a thesis on some topic related to the work of the College of Business Administration. Second term (3).

## LATIN

PROFESSOR WRIGHT, MR. BRIDGE

45. Ovid. Selections from the *Metamorphoses*. Vergil. *Bucolics*. Lectures on the history and development of pastoral poetry. The influence of Latin poetry upon English literature emphasized. Insistence upon tasteful translation. Freshman. First term (3).

46. Horace. Select *Odes*. Lectures on the history and development of lyric poetry. Constant practice in reading the more important lyric metres. Memorizing of stanzas and passages from Horace. Freshman. Second term (3).

47. Ancient Civilization. A course aiming to impart a knowledge of ancient life and thought, with special emphasis on literature, art, science, and philosophy. Required reading in the best

English translations of ancient authors. Assigned topics for investigation and report. Lectures on the art, architecture, and daily life of the ancients, illustrated by stereopticon. Freshman. First and second terms (3).

Courses 45 and 46 are required of freshmen in the B.A. course who enter with four units of Latin; others in that course take Course 47, except that those who so prefer may, with the approval of the Professor of Latin, begin or continue Latin instead.

48. Livy. Selections from the books covering the war with Hannibal. Cicero. *De Amicitia. Letters.* Catullus. Select poems. A study of the literature and social life of republican Rome. Elective, sophomore year. *Prerequisites:* 45 and 46. First term (3).

49. Plautus and Terence. Careful study of a play of each with rapid reading of as much more as time permits. Private life of the Greeks and Romans. History of the drama at Rome. Elective, sophomore year. *Prerequisites:* 45 and 46. Second term (3).

50. Satire. Selected satires of Horace and Juvenal. Martial. Selected epigrams. Lectures on the history of Roman satire and its influence on modern literature. Study of social conditions under the Empire. Elective, junior and senior years. *Prerequisites:* 48 and 49. First term (3).

51. Tacitus. *Annals.* Portions of those books which deal with the life and principate of the Emperor Nero. Elective, junior and senior years. *Prerequisites:* 48 and 49. Second term (3).

52. Vergil. *Aeneid,* Books VII-XII. Lectures on the history of the epic. Writing of brief dissertations on assigned topics. Elective, junior and senior years. *Prerequisites:* 48 and 49. First term (3).

53. Lucretius. Careful study of one book entire of the *De Rerum Natura,* with reading of selections from the other books. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Elective, junior and senior years. *Prerequisites:* 48 and 49. Second term (3).

54. High School Latin. For prospective teachers of Latin in secondary schools. Prose composition and a review of secondary

school Latin, the members of the class conducting the class in turn under the oversight of the Professor of Latin to the end that they may enter upon the teaching of Latin in preparatory or high school with freshened knowledge of the subject and with some experience in presenting it. This course is ordinarily taken in connection with courses in education. Junior year. *Prerequisites:* 48 and 49. First and second terms (2).

54a. CICERO. Orations and Letters. Prose composition and syntax, with special emphasis on clause construction. A course designed for students who enter with two years of high school Latin and who elect to continue their Latin rather than take Course 47. First term (3).

54b. VERGIL. *Aeneid,* Books I-VI. Prose composition continued. Practice in reading aloud and scansion. Training in sight translation. Some study of the mythology and religion of Greece and Rome. Second term (3).

54c. BEGINNING LATIN AND CAESAR. Special emphasis on English derivatives and the principles of grammar. First and second terms (3).

## GREEK

PROFESSOR GOODWIN

55. LYSIAS. Selected *Orations;* or XENOPHON, *Memorabilia.* Review of the grammar. Composition and other exercises. Careful study of Attic prose syntax; special attention given to the formation of correct methods of study and translation, to grammatical analysis, and to the reading aloud of Greek. Available time employed in sight-reading. HERODOTUS. One book begun. *Prerequisites:* 64 and 65, or Entrance Greek. First term (3).

56. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. *Euthyphro, Apology,* or other shorter dialogues. Introduction to Greek philosophy. Grammar and composition as in the first term. *Prerequisite:* 55. Second term (3).

57. THUCYDIDES. One or more books. Composition. *Prerequisites:* 55 and 56. First term (3).

58. TRAGEDY. EURIPIDES. *Medea, Bacchae,* or another play. SOPHOCLES. *Oedipus Tyrannus, Antigone,* or another. Literary study of the drama. Poetical language, style, and conception. Metrical

reading. Composition. *Prerequisites:* 55 and 56. Second term (3).

59. Dramatic Poetry (continued). Aeschylus. *Agamemnon,* or *Prometheus Bound.* Aristophanes. *Clouds, Frogs,* or *Birds.* Aristotle. Chapters from the *Poetics.* Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. *Prerequisites:* 55, 56, 58. First term (3).

60. Greek Oratory. Jebb's *Selections from the Attic Orators.* Demosthenes. Selected orations. Rapid reading, the student being supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention directed largely to those points which illustrate the development of Greek prose style. *Prerequisites:* 55 and 56. Second term (3).

61. Homer. Rapid reading of considerable portions of the *Iliad* or *Odyssey.* Homeric language, syntax, and metre reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in Course 62. *Prerequisites:* 55 and 56. First term (3).

62. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar or Theocritus. Study of the development of poetry in Greece. *Prerequisites:* 55, 56, and 61. Second term (3).

63. Hellenistic Greek. *New Testament.* Selections from Lucian. To be substituted on occasion for 62. *Prerequisites:* 55, 56, and the approval of the Professor. Second term (3).

Courses 59 and 61, 60 and 62 (or 63) are offered in alternate years, and are open to both juniors and seniors. Candidates for honors in Greek will be assigned special readings on request.

64. Elementary Greek. A course offered (ordinarily only in alternate years) to freshmen and sophomores who have entered without Greek, but who desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with Course 55. The introductory book and a small portion of the *Anabasis* are studied in the first two terms. Given in 1923-1924; to be omitted in 1924-1925 (unless at least six applications are received). *Prerequisite:* None, but some knowledge of Latin is highly desirable. First and second terms (3).

65. Second-Year Greek. *Anabasis* continued; *Iliad* (if time permits); grammar and simple composition. Offered only when Course 64 has been given in the preceding year. *Prerequisite:* 64, or one year of Entrance Greek. First and second terms (3).

## GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE, MR. ROEST

70. Elementary German. German grammar and composition. Easy German texts. First term (3).

71. Elementary German, continued. Composition based on work in the grammar. Dictation. Reading of short stories by various modern authors. *Prerequisite:* 70, or the equivalent. Second term (3).

73. Chemical German. Rapid reading of selected texts on chemistry. For sophomore chemical engineers who have passed Course 71. *Prerequisites:* 71, or the equivalent. First term (2).

75. Modern German Prose. Thorough review of German grammar. Prose composition. Scientific German. *Prerequisite:* Entrance Grammar or 71. First and second terms (3).

77. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. *Prerequisite:* Entrance German or 71. First and second terms (3).

78. Modern German Prose (continued). Rapid reading of representative texts. *Prerequisite:* 75 or 77. First term (3).

79. Goethe's Faust. Study of Part I. Lectures on the origin and development of the Faust story. *Prerequisite:* 77 or the equivalent. Second term (3).

80. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. *Prerequisite:* 77 or the equivalent. First and second terms (3).

81. Goethe's Dramas: *Goetz, Egmont, Iphigenie, Tasso, Faust,* Part II. *Prerequisite:* 77 or the equivalent. First and second terms (3).

82. The German Short Story. Origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. *Prerequisite:* 77 or the equivalent. First and second terms (3).

83. Methods in German. A course for prospective teachers in advanced German grammar. German composition, methods of teaching, and discussion of text-books. *Prerequisites:* 78 and 79, or the equivalent. First term (2).

## ROMANCE LANGUAGES

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY,

MESSRS. EWING, PERKINS, BARTHOLD, CONVERS

### FRENCH

90. Elementary French. Elementary French grammar. Easy readings in French prose. Practice in speaking and writing simple French, based upon the texts used. A course intended primarily for junior students in the College of Arts and Science; introductory to Course 97. First and second terms (3).

91. Elementary French. An intensive course in elementary French for senior Metallurgists. Emphasis upon the development of a reading knowledge of French. Grammatical drill limited to the essentials. First term (3).

92. Elementary French. A sophomore elective for students in the College of Arts and Science who wish three years of French and can therefore give time to a more detailed drill in grammar and composition as well as practice in writing and speaking; introductory to Course 97. First and second terms (3).

93. French Oral Composition. A course for students who wish a greater opportunity to practice in the oral and written use of modern French prose. Especially recommended for those who expect to teach French. First and second terms (2).

94. French (continued). A course for freshmen who enter on French. Thorough review of the grammar with composition work, both oral and written, based upon the grammar and upon the texts read. Texts selected from writers of modern French prose. *Prerequisite:* Entrance French. First and second terms (3).

96. French: Text and Methods. First or second term, or both (1 or 2).

97. French: Rapid Reading. Sight Translation. Dictation. Oral drill in the use of a practical vocabulary. *Prerequisite:* 90 or 92. First and second terms (3).

98. French Prose and Poetry. Balzac, Flaubert, Maupassant, Daudet, Zola. *Prerequisite:* Entrance French. First term (3).

99. French Prose and Poetry (continued). Molière, Corneille, Racine. Society in the seventeenth century. *Prerequisite:* 98. Second term (2).

100. French Literature in the Seventeenth Century. *Prerequisites:* 98 and 99. First term (3).

101. French Literature in the Eighteenth Century. *Prerequisites:* 98 and 99. Second term (3).

102. French Social Forces. Rapid reading of modern French authors, introducing certain of the social and political problems of France and her people today. Reading of texts by such authors as Thiers, Lamartine, and Michelet, to furnish the necessary background. *Prerequisites:* 100 and 101. First and second terms (3).

103. French Literary History. General review of French literature. Reading, lectures, and explanation of texts. *Prerequisites:* 100 and 101. First and second terms (3).

104. French Literature in the Nineteenth Century. *Prerequisites:* 100 and 101. First and second terms (3).

105. French Literature in the Sixteenth Century and Earlier. May be substituted in place of 102, 103, or 104. *Prerequisites:* 100 and 101. First and second terms (3).

### SPANISH

109. Elementary Spanish. A beginners' course intended primarily for students in Arts and Science. First and second terms (3).

110. Elementary Spanish. Grammar, reading, and composition. A course open to all students of the University. First and second terms (3).

111. Spanish: Latin-American History. Reading and discussion in Spanish of texts dealing with the history of Latin-American countries. Prose composition. *Prerequisite:* Entrance Spanish. First and second terms (3).

112. Spanish Continued. A continuation of Course 110. *Prerequisite:* 110. First and second terms (3).

113. Spanish Continued (for Business Students). A course similar to Course 111 but intended primarily for students in Business Administration. *Prerequisite:* Entrance Spanish. First and second terms (3).

114. Spanish Novels and Plays. Short outline of Spanish literature. A second-year course, intended more especially for students in the B.A. course; may be substituted by them for Course 112. *Prerequisite:* 109 or 110. First and second terms (3).

115. Spanish. Reading and discussion in Spanish of texts dealing with the commercial and industrial relations of Latin-America. Spanish commercial correspondence. *Prerequisite:* 113. First and second terms (3).

### PORTUGUESE

116. Elementary Portuguese. Grammar and composition. Rapid reading of modern literature, with particular reference to the history and social and economic conditions in Brazil and Portugal. First and second terms (3).

117. Portuguese Continued. *Prerequisite:* 116. First and second terms (3).

### ITALIAN

118. Elementary Italian. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

119. Italian Continued. Masterpieces of the classic periods; outside reading. *Prerequisite:* 118. First and second terms (3).

## ENGLISH

PROFESSORS THAYER AND LUCH,

ASSISTANT PROFESSOR MESCHTER, MESSRS. LAMBERT AND SMILEY

120. Rhetoric. A composition course based on Genung's *Working Principles of Rhetoric* and Thomas, Manchester, and Scott's *Composition for College Students.* Recitations and themes on assigned subjects. First term (3).

121. American Literature. Lectures and recitations on the basis of Pattee's *Century Readings in American Literature* and other text-books, as assigned. Examination based upon the text-book and the student's notes. Required reading: Foerster's *Essays for College Men.* Second term (3).

122. History of the English Language. Lectures and classroom work, with the use of Emerson's *Brief History of the English Language* as a text-book, supplemented by Trench's *Study of Words* (revised edition). For B.A. and B. S. students. Second term (3).

123. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Cunliffe, Pyre, and Young's *Century Readings in English Literature.* Required reading: *Adventures in Essay Reading* (Harcourt, Brace & Co.) For sophomores. First term (3).

124. Literary Criticism. Subject varying annually between topics taken from Elizabethan literature, lyric or dramatic, and from nineteenth century literature, earlier or later period. In 1924-5, Shakespeare, selected plays; Maccracken, etc., *Introduction to Shakespeare;* Phelps, *Twentieth Century Theater.* Second term (3).

125. Oratory. An introductory course based upon Collins's *Platform Speaking,* with recitations, the composition and delivery of orations, and speeches on topics of current interest. For B.A. and B.S. freshmen. Second term (1).

126. Anglo-Saxon. Sweet's *Anglo-Saxon Primer and Reader,* with lectures on early English literature, and readings from Brooke and Earle. Junior elective. First term (3).

127. Technical Writing. A course of practical exercises in writing on scientific subjects. Text-book: Harbarger, *English for Engineers.* Required reading: Smith's *Essays and Studies.* For juniors. Second term (2) or (3).

128. English Philology. The principles of the philology of the English language as developed in the works of Earle, Trench, Morris, and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic tongue; with special reference to the intensive development of the language before the Age of Chaucer. Junior elective. *Prerequisite:* 126. Second term (3).

129. Nineteenth Century Literature. Later period, 1830-1892: Tennyson, Arnold, and Browning and some of the minor poets; or, in alternate years, the earlier period. Junior elective. First term (3).

130. Middle English. A critical study of the English of Chaucer, Langland, and Gower; followed by the literary study of selected specimens of their works. Text-books: *The Student's Chaucer,* Skeat's edition of *The Vision of Piers the Plowman,* and Gower's *Confessio Amantis* assigned. Senior elective. First term (3).

131. Poetics. A course based on Gummere's *Handbook of Poetics,* Alden's *English Verse,* Saintsbury's *Loci Critici,* with the use of Palgrave's *Golden Treasury* and *The Oxford Book of English Verse,* with practical exercises in verse-composition. Senior elective. Second term (3).

132. Drama of the Past. Based on Brander Matthew's *Chief European Dramatists;* with lectures, interpretations, and a close study of plots and sources. First term (3).

133. Contemporary Drama. Lectures, criticisms, and reading of typical plays. Text-books: Dickinson, *Chief Contemporary Dramatists,* Series 1 and 2; Lewis, *Contemporary One-Act Plays;* Baker, *Modern American Plays;* and Chandler, *Aspects of Modern Drama.* Open to juniors and seniors. Second term (3).

134. Twentieth Century Literature. The drama, the novel, and lyric poetry since 1895. Cunliffe, *English Literature of the Last Half Century;* Follett, *Some Modern Novelists;* Sherman, *On Contemporary Literature;* etc. Senior elective. Second term (3).

137. English Conferences. For seniors. First or second term (2) or (3).

## MATHEMATICS AND ASTRONOMY

~~PROFESSORS THORNBURG, LAMBERT, AND OGURN~~

PROFESSORS THORNBURG, LAMBERT, AND OGBURN, Reynolds spoken

ASSISTANT PROFESSOR KNEBELMAN, MESSRS. LEYZERAH, SOLT, LYLE

140. Solid Geometry, beginning with Book VI and completing the subject. Second term (3).

141. Plane Trigonometry. Including the theory and use of logarithms. First term (3).

142. Spherical Trigonometry. Including the use of logarithmic tables. Second term (1).

143. Advanced Algebra, beginning with the Theory of Quadratic Equations. Review of Plane Trigonometry and Elementary Algebra. First term (4).

144. Higher Algebra. Theory of Equations. Determinants, Sturm's Functions, Cardin's Solution of the Cubic, Euler's Solution of the Biquadratic. *Prerequisite:* 143. First term (1).

145. Plane Analytic Geometry. Graphic representation of loci on cross-section paper. Plane Analytic Geometry. Second term (3).

146. Differential Calculus and Solid Analytical Geometry. Embracing applications to analytic geometry and practical problems. *Prerequisites:* 143, 145.

147. Integral Calculus. General integration methods with applications to theory of Center of Gravity and Moment of Inertia, together with a short chapter on Elementary Ordinary Differential Equations. *Prerequisite:* 146. Second term (4).

148. Differential Equations. *Prerequisite:* 147. First term (1).

149. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. *Prerequisite:* 147. First term (2).

150. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. First or second term (3).

151. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. *Prerequisites:* 141, 142, 147, 150. First term (3).

152. Analytic Mechanics. *Prequisites:* 147, 148, 149. Second term (3).

153. Navigation. Study of principles and instruments used in navigation, with practical navigation problems by modern methods. *Prerequisite:* 150. Second term (2).

154. Business Mathematics. Interest and Discount, Annuities, Sinking Funds, Bonds, Depreciation, Insurance. Second term (3).

155. Differential Equations. Hyperbolic functions, Elementary functions of Complex Variables, Solution of Total Differential Equations, Symbolic Operators, Solution in Series, Fourier's Series, Elementary Partial Differential Equations. *Prerequisites:* 146, 147. Two terms (3).

156. Unified Mathematics. Selected Topics in Algebra, Trigonometry, and Analytic Geometry.

## CIVIL ENGINEERING

PROFESSORS FOGG AND WILSON,

ASSOCIATE PROFESSORS BECKER AND FULLER,

ASSISTANT PROFESSORS PAYROW, LEWIS, AND UHLER, MR. NOYES

160. Engineering Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing of objects. Simple projections. Isometric drawing. First term (3).

161. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Plans, elevations, and sections of simple structural details. *Prerequisite:* 160. Second term (2).

162. Engineering Drawing. The use of drawing instruments; lettering and simple projections. Second term (1).

163. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Isometric drawings, plans, elevations, and sections of simple structural details. *Prerequisite:* 162. First term (3).

164. Engineering and Topographic Drawing. Problems in stone cutting, including plans for pipes, culverts, and arches. Isometric drawings and linear perspective. Topographic maps. *Prerequisite:* 163. Second term (2).

165. Land and Topographic Surveying. The theory and practice of land surveying, including computation of areas, dividing land, determining heights and distances. Map drawing and topographic signs. Field work with level and transit. Map drawing from students' field notes. Theory and use of stadia. Detailed

field work in rough country; pen topography and contour maps. *Prerequisite:* plane trigonometry and engineering drawing. Summer term: a recitation and seven hours of field work each week-day for four weeks, beginning June 11, 1924.

166. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves. *Prerequisite:* 165. Summer term: a recitation and seven hours of field work each week-day for two weeks, immediately following Course 165.

167. Mechanics of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. *Prerequisites:* 320, 321, 324, 147. First term (4).

167a. Mechanics of Materials. An abridgement of Course 167. *Prerequisites:* 320, 321, 324, 147. First term (3).

168. Materials Testing Laboratory. Fourteen experiments made by each student on wood, iron, and steel to determine the action of materials under stress and to study the physical properties of materials of construction. The Fritz Engineering Laboratory, where this work is done, is equipped with 20,000, 50,000, 100,000, 300,000, and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion, and other apparatus for special work. Concurrent with 167 or 167a. Fee, $5. First term (1).

169. Railroads. Theory of curves and turnouts. Preparation of profiles and maps. The computation of earth work and estimates of cost. The construction of road-bed, including ballast, cross ties, rails, switches, culverts, and other details. *Prerequisite:* 166. First term (4).

170. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. The solution of many practical problems. *Prerequisites:* 320, 321, 324, 147. Second term (3).

170a. Hydraulics. An abridgment of Course 170. *Prerequisites:* 320, 321, 324, 147. Second term (2).

171. Hydraulic Laboratory. Fourteen experiments made by each student in the hydraulic section of the Fritz Engineering

Laboratory, which is equipped with pumps, weirs, turbines, water-wheels, meters, and other apparatus for special work. Concurrent with 170 or 170a. Fee, $5. Second term (1).

172. Roofs and Bridges. Analytical and graphical determination of stresses in roof and bridge trusses under dead, live, and wind loads. Locomotive wheel loads on plate girders and bridge trusses. *Prerequisite:* 167 or 167a. Second term (4).

173. Highway Engineering. The location, construction, and maintenance of roads and pavements. Highway design. *Prerequisites:* 165, 166. Second term (3).

174. Graphic Statics and Surveying. A special course given to junior Mechanical Engineering students. The first part of the term is devoted to the graphical determination of stresses in roof trusses by the force polygon. The last part of the term is devoted to elements of plane surveying, including field work. *Prerequisite:* 320, 321. Second term (3).

175. Structural Steel Design. Lectures and recitations. Theory of structural steel design and complete calculations for a through plate girder railroad bridge and for a highway truss bridge. Design of mill buildings and miscellaneous structures. *Prerequisite:* 172. First term (3).

176. Structural Steel Design. A special course arranged for seniors in Marine Engineering. A study of the stresses acting on steel structures, with special attention to the local stresses in a ship's structure; the design of cranes, warehouses, and other steel structures; solution of problems by graphical methods. *Prerequisites:* 167 or 167a. First term (3).

177. Bridge Design Drawing. Complete shop drawing for a single track through railroad bridge and a design drawing of a highway truss bridge for which calculations are made in Course 175. Concurrent with 172. First term (3).

178. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. *Prerequisites:* 320, 321. First term (2).

179. Hydraulic and Water Power Engineering. Three recitations and one drawing-room exercise a week devoted to systems of water supply, including purification of systems, reservoirs, pipe

lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. *Prerequisites:* 170 or 170a. First term (4).

180. Geodesy. Recitations, calculations, field work. Precise leveling. Adjustment of instruments and investigation of their systematic errors. Elements of least squares and their application to the adjustment of triangulations. Field work in triangulation, in determination of azimuth, and with the plane table. *Prerequisites:* 165, 166. First term (3).

181. Railroads and Terminals. Maintenance of way, and the elements of railroad operation. Lectures on the economics of railroad location; the arrangement of yards, stations, and terminals; train resistance; the application of electricity to the operation of railroads. *Prerequisite:* 169. First term (3).

182. Higher Structures. Theory of continuous, draw, cantilever, and suspension bridges; also metallic arches. The theory and design of masonry walls, dams, and arches. Theory of deflections and applications to statically indeterminate structures. *Prerequisite:* 172. Second term (3).

183. Reinforced Concrete Design and Foundations. Theory of reinforced concrete; design of reinforced concrete buildings, arches, and miscellaneous structures. Foundations. *Prerequisites:* 167 or 167a; highly desirable, 172. Second term (3).

184. Cement and Concrete Laboratory. The manufacture, properties, and testing of cement, mortar, and concrete. All the standard tests are made by each student on cement and on reinforced concrete beams and columns in the Fritz Engineering Laboratory. Concurrent with 183. Fee, $3. Second term (1).

185. Contracts and Specifications. Lectures on the essentials of contracts and specifications for engineering structures. *Prerequisite:* Junior standing. Second term (2).

186. Sanitary Engineering. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. *Prerequisite:* 179. Second term (3).

165. Land and Topographic Surveying. Exercises in land and topographic surveying, designed primarily for students of the

University, but open to all persons prepared to take them, are given in the summer vacation. In 1924, this work begins at 8 a.m., on June 11, and runs for three full weeks. Students in Civil Engineering, in Mining Engineering, and in Marine Engineering are required to take this work. The fee for other persons is $30.

166. Railroad Surveying. Exercises in railroad surveying, beginning immediately after the close of Course 165 and running for two full weeks.

187. Summer Work in Civil Engineering. During the summer following the junior year, students are required to spend at least eight weeks in shop work or on engineering construction.

## MECHANICAL ENGINEERING

PROFESSORS LARKIN, KLEIN, AND BUTTERFIELD,

ASSOCIATE PROFESSOR MEASE,

ASSISTANT PROFESSORS QUAST AND NORDENHOLT,

MESSRS. LEACH, KOLB, AND KISTLER

200. Drawing and Elements of Machine Design. Orthographic, isometric, and oblique projections, intersections, and developments. Sketches and working drawings of machine pieces, tracings, details of screw-fastenings, keys, and other fastenings. *Prerequisite:* 321. First term (3).

201. Heat Engines. Classification and types of engines, governors, valve gears, valve diagrams, indicator diagrams, efficiency. Fuels, combustion, boilers, superheaters, feed water heaters, condensers. *Prerequisite:* 321. First term (3).

202. Mechanism. A study of the mechanics of machine parts. Development of links, cams, gears, transmission machinery, and the determination of dimensions from the standpoint of strength and durability taken up in detail in the class room. Practical problems developed in the drawing-room. *Prerequisite:* 320. First term (3).

203. Elements of Machine Design. Calculations of the dimensions of elementary machine parts, such as spur-, bevel- and worm-gears, pulleys, shafting, couplings, bearings, connecting rods, etc., from the forces acting upon or transmitted by such machine

parts. Working drawings of these pieces. *Prerequisite:* 320. Second term (3).

204. Heat Engines. Continuation of 201. Second term (3).

205. Mechanism. Continuation of 202. Second term (3).

206. Graphic Statics of Mechanisms. Graphical determination of the forces acting on all the various pieces constituting a machine, covering a great variety of machines; drawings of these machines given to the students. Consideration of frictional and inertia resistances and determination of the efficiencies of mechanisms. *Prerequisite:* 321. Fee, $2.50. First and second terms (2).

207. Heat Engines. Theory of Steam Turbines, Internal Combustion Engines, Gas Producers, and Refrigeration. Class and drawing-room work. *Prerequisite:* 204. First term (4).

208. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. *Prerequisite:* 201. Fee, $3.50. First term (1).

209. Heat Engines. Theory of Steam Turbines, Internal Combustion Engines, Gas Producers, and Refrigeration. Continuation of 207. Second term (4).

210. Engineering Laboratory. Work of 208 continued. Indicator practice on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. *Prerequisite:* 201. Fee, $3.50. Second term (1).

211. Advanced Machine Design. The design of machines in general, with special attention to the calculation and designing of the various parts for strength, stiffness, and other requirements. Problems covering such machinery as cranes, hoists, pumps, machine tools, hydraulic machinery, etc. *Prerequisites:* 203; 167a. First term (4).

212. Mechanical Engineering. Advanced work in Thermodynamics, Internal Combustion Engines, and Steam Turbines, with typical problems. *Prerequisites:* 147; 209. First term (4).

213. Engineering Laboratory. Work of 208 and 210 continued. Test of boilers, of power plants and pumping stations in the neighborhood. *Prerequisite:* 210. Fee $3.50. First term (1).

214. Thesis. Each candidate for the degree of Mechanical Engineer is required to present a satisfactory thesis on some topic, showing a grasp of the underlying principles of the subject investigated. *Prerequisite:* 209. Second term (3).

215. Advanced Machine Design. Continuation of 211, being more specialized. *Prerequisites:* 203; 167a. Second term (4).

216. Mechanical Engineering. Continuation of 212. Advanced work in Pumping Machinery, Air Machinery, and Refrigeration, with typical problems. *Prerequisites:* 147; 209. Second term (4).

217. Engineering Laboratory. Work of 213 carried forward, along the same lines. Analysis of flue gases; complete tests of power plants of the vicinity. *Prerequisite:* 210. Fee, $3.50. Second term (1).

218. Heat Engineering. The laws of gases and the gas cycles; the properties of steam and other vapors, the vapor cycles, entropy and the temperature-entropy diagram; a study of the theory of prime movers and the action of steam in engines and turbines; the use of the steam tables, the Mollier and temperature entropy diagrams. For students in the Curriculum in Marine Engineering. *Prerequisite:* 321. First term (3).

219. Mechanical Engineering. A study of steam turbines, multiple expansion engines, and valve gears, for students in Marine Engineering. *Prerequisites:* 218 and 454. Second term (2).

220. Engineering Laboratory. A shorter course, selected and condensed from 208, 210, 213, and 217, especially in steam engineering, for students in curricula other than Mechanical Engineering. *Prerequisite:* 201 or the equivalent. Fee, $3.50. First term (1).

221. Heat Engines. Short course for students in courses other than Mechanical Engineering, covering Steam Engines, Steam Turbines, Internal Combustion Engines, and Boiler Plants. *Prerequisite:* 321. First term (3).

222. Heat Engines. Work of 221 completed. *Prerequisite:* 321. Second term (3).

223. Heat Engines. Classification and types of engines and power plant auxiliaries and apparatus, fuels, combustion, steam

turbines, internal combustion engines; a composite course for students in the curriculum in Chemical Engineering. *Prerequisite:* 321. First term (3).

224. Heat Engines. Continuation of 223. *Prerequisite:* 321. Second term (3).

225. Engineering Laboratory. A summer course of four weeks for students in Chemical Engineering, comprising a series of experiments and tests of heat transfer, apparatus, calorimetry, heat engines, and auxiliaries. *Prerequisites:* 223, 224. Fee, $3.50. Summer term (3).

226. Engineering Laboratory. Work of 220 completed, along the same lines. *Prerequisite:* 204 or the equivalent. Fee, $3.50. Second term (1).

227a. Work in Industrial Plant. Following the freshmen year students are required to attend a R. O. T. C. camp, or to spend a minimum of eight weeks in an industrial plant of approved character. A report is required. Summer term (3).

227b. Work in Industrial Plant. Following the sophomore year students are required to spend a minimum of eight weeks in industrial plants of approved character. A report is required. Summer term (3).

228. Student Apprenticeship, or Engineering Construction, or Shop Work. Following the junior year students are required to do a minimum of eight weeks of practical work, preferably as student apprentices, in the work they plan to follow after graduation. A report is required. Summer term (3).

## METALLURGY

PROFESSOR STOUGHTON,

ASSOCIATE PROFESSOR ROUSH,

ASSISTANT PROFESSORS BUTTS AND PULSIFER

241. History of the Metals. A course of lectures designed to familiarize the beginning student with the historical phases of metallurgy and the importance of metals in the development of civilization. *Prerequisite:* 390. Second term (1).

242. Introductory Metallurgy. A course of lectures on the properties and uses of the various metals, the geographical dis-

tribution of their ores, and the condition of their production; their present economic and industrial importance. *Prerequisite:* 241. First and second terms (1).

243. General Metallurgy. A course of lectures discussing the general principles of metallurgy as applied to the metallurgy of the various metals. Ores, fuels, combustion, pyrometry, refractories, furnaces, metallurgical processes and products, metals and alloys, slags and fluxes, blast and gases, smoke and fume. Hofman's *General Metallurgy;* Fulton's *Principles of Metallurgy. Prerequisites:* 242, 398, 399. First term (2).

244. Metallurgical Problems. A course of problems embodying the use of the physical, chemical, and mechanical principles as the basis of practical metallurgy. Data are taken, so far as possible, from actual practice, so that the results have an important bearing in the understanding of metallurgical processes. Reference: Richards' *Metallurgical Calculations, Part I. Prerequisites:* 242, 397. Must accompany Course 243. First term (1).

245. Metallurgy of Iron and Steel. Chemical and physical properies of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Refining. Puddling. The Bessemer process. The open-hearth process. Duplex process. Cementation. Manufacture of crucible steel. Electric steel. Alloy steels. Casting, forging, and heat treatment. Text-book: Stoughton's *Metallurgy of Iron and Steel. Prerequisite:* 243. Second term (2).

246. Metallurgical Problems. A course of problems involving the fundamental principles of the various processes in the metallurgy of iron and steel, to give the student an understanding of the quantitative relationships in the processes. Richards' *Metallurgical Calculations, Part II. Prerequisites:* 243, 244. Must accompany Course 245. Second term (1).

247. Metallurgy: Short Course. An abridgment of courses 243, 244, 245, and 246 for students in Civil, Mechanical, Electrical, Mining, and Marine Engineering. Reference books: Hofman's *General Metallurgy,* Stoughton's *Metallurgy of Iron and Steel,* Austin's *Metallurgy of the Common Metals,* Richards' *Metallurgical Calculations, Parts I and II. Prerequisites:* 390, 397, 321. Must accompany or be preceded by 324. First or second term (3).

248. METALLURGY OF COPPER, LEAD, SILVER, AND GOLD. COPPER: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet process. Electrolytic processes. LEAD: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. SILVER: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. GOLD: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Reference books: Gowland's *Metallurgy of the Non-Ferrous Metals,* Austin's *Metallurgy of the Common Metals,* Schnabel's *Handbook of Metallurgy,* Hofman's *Metallurgy of Copper,* Hofman's *Lead,* Collins' *Silver,* Rose's *Gold. Prerequisite:* 234; for Mining Engineers, 247. First term (2).

249. METALLURGICAL PROBLEMS. A course of problems concerned with the principles utilized in the metallurgy of copper, lead, silver, and gold. Reference: Richards' *Metallurgical Calculations, Part III. Prerequisite:* 244. Must accompany Course 248. First term (1).

250. METALLURGY OF ZINC, MERCURY, TIN, ALUMINUM, NICKEL, ETC. ZINC: Chemical and physical properties. Ores. Reduction by furnace and electrolytic processes, electrothermic processes. Manufacture of zinc oxide. MERCURY: Chemical and physical properties. Ores. Processes of extraction. ALUMINUM: Chemical and physical properties. Ores. Extraction by electrolysis. TIN, NICKEL, PLATINUM, ANTIMONY, etc.: Chemical and physical properties. Ores. Processes of extraction. Reference books: Gowland's *Metallurgy of Non-Ferrous Metals,* Austin's *Metallurgy of the Common Metals,* Schnabel's *Handbook of Metallurgy,* Ingall's *Zinc,* Richards' *Aluminum,* Louis' *Metallurgy of Tin,* Wang's *Antimony. Prerequisite:* 243. Second term (2).

251. METALLURGICAL PROBLEMS. A course of problems concerned with the principles utilized in the metallurgy of zinc, mercury, aluminum, etc. Reference: Richards' *Metallurgical Calculations, Part III. Prerequisite:* 244. Must accompany Course 250. Second term (1).

252. ELECTROCHEMISTRY. Lectures discussing the historical development of the subject, particularly the phenomena of elec-

trolysis and the various theories proposed to account for them. Current phenomena. Voltage phenomena. Energy relations. Electrode reactions. The electrolytic cell. Electrothermics. Reference books: Le Blanc's *Text-book of Electrochemistry.* Allmand's *Applied Electrochemistry. Prerequisites:* 398, 399, 419, 421. First term (1).

253. Electrometallurgy. Lectures discussing the practical application of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: McMillan's *Electrometallurgy.* Allmand's *Applied Electrochemistry. Prerequisites:* 243, 252. Second term (1).

254. Electrochemistry and Electrometallurgy. A combination of Courses 252 and 253, for students in Electrical and Mining Engineering. *Prerequisite:* 247. First term (2).

255. Electrochemical Laboratory. Quantitative relations in the deposition of metals by electrolysis. Experimental study of the conditions controlling the nature of electrolytic deposits. Electrolysis of fused salts. Cathodic and anodic reactions. Must accompany Course 252. Fee, $5. First term (1).

256. Metallurgical Laboratory. Principles of process metallurgy; such as alloying, galvanizing, measurement of air volume and moisture content, desilverization of lead, cementation of steel, electrolysis, hydrometallurgy, heat transfer, heat conduction, and radiation. Principles of physical metallurgy, such as the effect of mechanical work and heat treatment, influence of impurities, etc. Calibration and use of instruments employed in metallurgical investigations, pyrometers, calorimeters, etc. Determination of efficiencies of furnaces. Experiments with electrochemical processes, electric furnaces, etc. *Prerequisites:* 243, 245. Fee, $10. Second term, (2).

257. Metallography. The study of metals and alloys: their physical, chemical, and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Reference books: Gulliver's *Metallic Alloys,* Sauveur's *Metallography and Heat Treatment of Iron and Steel. Prerequisites:* 243, 245, 167, 168. Fee, $10. First term (3).

258. Seminar. Conference hours of the staff of the department with students, to discuss current metallurgical literature, processes, and problems, and thesis work; involving reading of current English and foreign literature and verbal presentation by the students. First term (3). Second term (2).

259. Thesis for Degree. Presentation by every student in Metallurgy of a thesis on some topic which requires original literary and other work, such as observations, calculations, or experimental tests. Second term (4).

## GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSORS TURNER AND FRETZ, MR. BEHRE

266. Mineralogy. The principles of crystallography with practice in the determination of forms of models and crystals. The physical properties, origin, occurrence, association, and alteration of minerals. A study of about two hundred of the common mineral species and varieties, with practice in identification based on physical properties. Students should have had 390 and 391. Deposit, $5. First term (4).

267. Blowpipe Analysis. A course in qualitative blowpipe analysis in which the chemical and physical behavior of the common chemical elements and their compounds is noted. Methods of rapid qualitative tests for the identification of minerals and chemical compounds with the aid of the blowpipe. Students should have had 390 and 391. Fee, $4. First and second terms (1).

268. General Geology. A course in dynamic, structural, and historical geology. Text-book, supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. Second term (2).

269. Geological Laboratory and Field Trips. The course consists of two kinds of work, one hour per week devoted to the microscopic study of rocks and one hour to field trips. The field trips can be taken separately. When weather conditions prevent out-door work, laboratory exercises in the the study of maps are substituted. The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss, and serpentine are

obtained, all of which are visited by the classes. *Prerequisite:* 266, for laboratory work on rocks. Fee, $1. Second term (2) or (1).

270. Non-Metallic Economic Geology. A study of the origin, modes of occurrence, properties, sources, production, and uses of the non-metallic mineral products. The major portion of the course is devoted to petroleum, natural gas, and coal. *Prerequisites:* 266, 268, 269. First term (2).

271. Metallic Economic Geology. A study of the geological occurrence, distribution, uses, and commercial production of the metalliferous minerals. Includes consideration of the most important foreign districts. Recitations, illustrated lectures, field trips, and laboratory examination of ore specimens of representative districts of North and South America. Visits to the zinc mines of Franklin Furnace, N. J., and Friedensville, Pa., the magnetite mines of Dover, N. J., and Cornwall, Pa., and the anthracite coal regions. *Prerequisites:* 266, 268, 269. Second term (4).

272. Paleontology. An elementary course in which the animal life of the past is considered from both the biological and geological viewpoints. Theories of origin and evolution of life; principles of stratigraphy and paleontology. Study in the laboratory of index fossils of the successive geologic periods. *Prerequisites:* 268, 269. Second term (3).

273. Geology of North America. The geological age and geographical distribution of the rocks of the North American continent; the structure and history of its mountain ranges; the history of its geological development. For those who have not already had Course 272, a few weeks are devoted to a study of the characteristics and evolution of fossil forms. *Prerequisites:* 268, 269. Second term (3).

274. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development. Study of topographic and geologic maps. The relation of topography to geologic structure. The influence of physiography upon the economic development of countries. Brief study of weather and climate. Second term (2).

275. Field Geology. Practice in the actual working out of surface geology, each student being assigned a definite area and required to make a geological map of it with structure sections. Collection by each student of a full set of specimens to illustrate the geology. The first part of the course is devoted exclusively to field work, and the notes and specimens are studied in the laboratory when the weather prevents further out-door work. *Prerequisites:* 268, 269. Fee, $1. First term (3).

276. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the most important igneous rocks. Lectures, recitations, and laboratory work. *Prerequisite:* 266. Fee, $3. First term (2).

277. Physiography. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. First term (2).

278. Physiography. A continuation of Course 277. Recitations, lectures, and laboratory work. Physiographic regions of North America and Europe. Topographic maps and the preparation of weather and climate charts. Second term (2).

279. Mining and Geologic Law. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products. *Prerequisites:* 268, 269. First term (1).

280. Structural Geology. The study of special features of structural geology in the field and laboratory. *Prerequisites:* 268, 269. First term (1).

281. Geologic Methods. Methods used by the United States Geological Survey and by the mining companies that employ geologists. Special attention to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. *Prerequisites:* 268, 269, 275. Second term (3).

## BIOLOGY

PROFESSOR HALL,* ASSOCIATE PROFESSOR THOMAS,

MR. KREIDLER, MR. OLD

290. Botany. An elementary course treating of the structure and classification of plants. Preparation advantageous: 292. Second term (3).

* On leave of absence, 1923-24.

291. Forestry. Lectures, recitations, and laboratory work. A brief introduction to botany, followed by lectures on dendrology and text-book work on forestry. Laboratory work devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the autumn to enable the student to become familiar with the trees of the region. First term (2).

[Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of forestry in connection with the conservation of our natural resources. It does not appear to the Trustees that the present demand for professional foresters is such as to justify the establishment of a school of forestry at the University. It does appear that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the section of country reached by the influence of the University to the need of a better knowledge of the principles involved. To this end courses of lectures have been instituted to which the public is invited and special instruction is given in forestry in certain of the courses. In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.]

292. Biology. Recitations from a text-book, laboratory work, and lectures on the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. Fee, $3. First term (3) or (5).

293. Comparative Anatomy of Vertebrates. Text-book work and recitations on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. Laboratory work consisting of the dissection of types of the several vertebrate classes. *Prerequisite:* 292. Second term (3).

294. Vertebrate Embryology. Lectures, text-book, and laboratory work. Study of living, preserved, and sectioned material

demonstrating the successive stages of cleavage, gastrulation, and the formation of organs. *Prerequisite:* 293. First term (3).

295. Sanitary Biology. Lectures, recitations, assigned reading, and laboratory work. Study of bacteria and allied microorganisms by staining and cultural methods; their sanitary importance in public water supplies. The bacteriology of sewage treatment. Qualitative and quantitative bacteriological and biological analyses of water, sewage, air, soil, milk, etc. Fee, $3. Second term (2).

296. Bacteriology. An elementary course in general bacteriology. Lectures, recitations, and laboratory work. After a general study of the morphological and cultural characteristics of bacteria and allied microorganisms, special attention is given to those forms of sanitary and economic importance. The role of bacteria, yeasts, and molds in fermentation industries, in the soil, and in disease is studied. Fee, $3. First term (2).

297. Advanced Bacteriology. Laboratory work and assigned reading. A thorough course in advanced laboratory technique. Pathological diagnostic tests for typhoid carriers, diphtheria, tuberculosis, etc., together with immunological reactions, such as the Wasserman test, Widal test, Shick test, etc., are studied in practice and theory. *Prerequisite:* 295 or 296. Fee, $3. Second term (2).

298. Physiology. A course in normal physiology, hygiene, and sanitation aiming to give that knowledge of the body and its functions which all should have. Emphasis on the application of such knowledge to personal hygiene and public sanitation. Second term (2).

## MINING ENGINEERING

PROFESSOR ECKFELDT, ASSOCIATE PROFESSOR BARTLETT

300. Mechanical Drawing. The use of instruments. Lettering and tracing. Isometric drawing. Sketches and working drawings of simple machine parts. Blue printing. Descriptive Geometry. Projections, intersections, and developments of cylinders, prisms, cones, etc. Application to graphical solution of mining problems. Second term (2). First term (1) or (2).

301. Mining Engineering; Prospecting. Modes of occurrence of minerals. Uses of geology. Prospecting for placers, veins,

and beds. Magnetic prospecting. Drilling, sampling. Valuation of property. Location of claims. Patenting mining ground. BORING. Use of bore-holes. Methods: by percussion and rotation. Special methods. Shaft sinking by boring. Survey of bore-holes. EXPLOITATION. Location of plant. Rock drilling; tools and machines. Explosives; blasting; safety regulations. Shaft and slope sinking; tunneling. Supporting excavations by timber, metal, masonry, or concrete. Systems of mining underground and at the surface. HAULAGE. Surface and underground methods. Motors and cars, wire rope, aerial tramways. Loading and unloading; storage of minerals. Transportation of workmen. Signaling. First term (4).

302. ORE DRESSING. General principles and physical properties upon which the recovery of minerals or metals from ores is based, followed by detailed study of machines and apparatus used in modern practice for coarse and fine crushing; classifying and preparation for concentration; various methods of concentration, including gravity and magnetic methods, oil flotation, etc. Application of above methods to various ores; mill schemes or flowsheets. Study of procedure followed for treatment of ores and coal in typical modern concentrating plants. Mill location, construction, arrangement of machinery, operation and costs. Visits to mills and anthracite breakers.

ORE DRESSING LABORATORY. Experimental work and tests on ores, giving practical application of principles and processes covered. A well-equipped modern laboratory gives opportunity for individual as well as class operation of the most approved machinery for the preparation of ores. *Prerequisite:* 266. Fee, $5. First term (3).

303. MINING ENGINEERING. HOISTING. Motors, ropes, attachments, receptacles. Safety appliances. Systems of hoisting. DRAINAGE. Surface water; prevention of access. Mine dams. Tunnel drainage. Mechanical drainage; water hoisting; pumping. Classes of pumps. VENTILATION. Atmosphere of mines. Pollution of air. Natural and mechanical methods of ventilation; systems. Types and efficiencies of ventilating machines. Instruments for testing air. Ventilating laws. LIGHTING. Methods employed. Safety lamps; electric lighting. Safety regulations. FIRST AID. Accidents; classes, causes. Means of prevention.

Rescue work. Hygiene of mines; rules and laws. First Aid to injured. RAILROAD CONSTRUCTION. Earthwork, trackwork, trestles, bridges, railroad structures, water tanks, yards. Second term (4).

304. MINE SURVEYING. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. RAILROAD SURVEYING. Preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. *Prerequisite:* 165. Fee, $1. Summer term at the end of the junior year, four weeks, beginning July 9, 1924.

305. MINING ENGINEERING. CONSTRUCTION MATERIALS. The use of stone, brick, concrete, metal, and wood for foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore bins, and docks. MINE ADMINISTRATION. Organization, employment of labor, management, mine accounts, principles of mining. First term (3). Second term (1).

306. OIL AND GAS TECHNOLOGY. Origin and distribution of petroleum and natural gas. General survey of the geological conditions surrounding their accumulation. Oil shales. Prospecting and mapping. Location of wells. Drilling; pumping. Special methods. Storage. Pipe lines. Tank cars. Second term (2).

307. MINING DESIGN. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. *Prerequisites:* 167, 178. Second term (3).

308. PROSPECTING. Surface indications of minerals, including oil, gas, and water. Geological interpretation of strata and outcrops. Prospecting on surface and underground. Boring; magnetic prospecting. Mapping. Sampling and valuation of prospects. Locating and patenting claims. This course is offered as an elective for B.A. students. First term (2).

## PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR FRY,
ASSISTANT PROFFESSORS FRAIM, MARTIN, AND KLEIN,
MESSRS. CONCILIO, ZINSZER, MAIZLISH, CRAFTS, WEBB

320. Elementary Mechanics. Statics. Lecture demonstrations and recitations. *Prerequisite:* Plane trigonometry. First term (3).

321. Elementary Mechanics. Dynamics. Heat. Lecture demonstrations and recitations. Second term (3).

322. Physical Measurements. Laboratory and lectures. Fee, $6. Second term (1).

323. Elementary Physics. Electricity and magnetism. Lecture demonstrations and recitations. *Prerequisites:* 320, 321. First term (3).

324. Physical Laboratory. Mechanics, heat, and electricity. *Prerequisites:* 320, 321, 322. Fee, $6. First term (1).

325. Elementary Physics. Light and sound. Lecture demonstrations and recitations. Second term (3).

326. Physical Laboratory. Electricity, magnetism, light, and sound. *Prerequisites:* 322, 323, 324. Fee, $6. Second term (1).

327. Advanced Theory of Electricity and Magnetism. Lectures and recitations. Ferro-magnetism, electro-magnetism, induced electromotive force and inductance, magnetic properties of iron, electric charge and the condenser, electric field, potential, electric oscillation and waves. *Prerequisites:* 146, 147, 323. First term (2).

328. Theory of Electricity and Magnetism; Pyrometry and Pyrometric Measurements. Lectures and recitations. Ferro-magnetism, electro-magnetism, induced electromotive forces and inductance, magnetic properties of iron, electric charges and the condenser, thermo-electricity, heat radiation theory, description and theory of pyrometric apparatus. *Prerequisites:* 146, 147, 323. First term (2).

329. Electrical Laboratory. Precise measurements. *Prerequisites:* 322, 323, 324, 326. Fee, $6. First term (1).

330. Electrical Laboratory. Precise measurements. Continuation of 329. *Prerequisite:* 327 or 328. Fee, $6. Second term (1).

331. Elementary Physics. A brief general course. Lecture demonstrations, recitations, and laboratory. Fee, $6 per term. First term (3). Second term (3).

332. Modern Physics. A non-mathematical account of the modern views concerning such subjects as the Nature of Matter, Radio-activity, X-rays, etc. First term (2). Second term (2).

333. Introduction to Theoretical Physics. Mechanics. Thermodynamics, the Kinetic Theory of Gases, the Wave Theory of Light, and the Mathematical Theory of Electricity and Magnetism. *Prerequisites:* 146, 147, 320, 321, 323, 325. First term (3). Second term (3).

334. Laboratory Physics. A laboratory course of advanced character to accompany Course 333. The experiments in general are designed to encourage originality on the part of the student. *Prerequisites:* 322, 324, 326. Fee, $6 per term. First term (2). Second term (2).

335. Advanced Electricity and Magnetism. The theory of electric oscillations, electric waves, and high frequency phenomena and measurements. *Prerequisite:* 333. First term (3).

336. Laboratory Physics. A laboratory course to accompany 335. *Prerequisite:* 334. Fee, $6. First term (1).

337. Physical Optics and Spectroscopy. Elementary treatment of the wave theory of light, interference, diffraction, polarization, etc. Exposition of some phases of spectroscopic phenomena. *Prerequisite:* 333. First term (3).

338. Laboratory Physics. A course accompanying 337. *Prerequisite:* 334. Fee, $6. First term (1).

339. Electric Discharges through Gases. The properties of gaseous ions, the experimental data leading to the electron theory, including a study of vacuum tube phenomena, ionization and resonance potential, photo-electricity, etc. *Prerequisites:* 333, 335. Second term (3).

340. Laboratory Physics. A course accompanying 339. *Prerequisite:* 334. Fee, $6. Second term (1).

341. Heat. A theoretical study of thermodynamics and heat radiations. *Prerequisite:* 333. Second term (3).

342. Laboratory Physics. A course to accompany 341. *Prerequisite:* 334. Fee, $6. Second term (1).

343. Thesis. The thesis which must be presented by each candidate for the Degree of Bachelor of Science in Engineering Physics will be based on one of the four courses offered in the senior year. First and second terms (4).

344. Photometry and Illumination. Lectures and recitations. Illumination standards, measurements of light and illumination, laboratory methods and devices, commercial methods and experiments, comparison of illuminants and illuminating devices, practical installations. *Prerequisite:* 325. First term (1).

345. The Teaching of Physics in Secondary Schools. Principles of scientific method. A study of class room practice in neighboring schools. Text-books and methods. First term (2).

346. Telegraphy. Practice in sending and receiving the Morse and International Codes based upon Western Union and U. S. A. Signal Corps practice. First term (1). Second term (1).

## ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSORS SEYFERT AND SCHEALER,
ASSISTANT PROFESSORS BEAVER AND GRUBER,
MESSRS. MILLER, DIAMOND, AND KINGSLEY

351. Electrical Distribution. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring; overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. First term (2).

352. Dynamos and Motors. Review of principles of electricity and magnetism with special reference to their application to the dynamo. The construction, operation, and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electromagnets, magnetism of iron; characteristic curves; armature windings. Illustrative problems. *Prerequisites:* 323, 324. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. *Prerequisites:* 323, 324. Fee, $6. Second term (1).

354. Dynamos and Motors. An abbreviated course adapted to those students who do not continue this subject in the following year; the principles and practice of direct current engineering, including: the elementary theory, construction, operation, and control of direct current generators and motors, electromagnets, solenoids, automatic starters and controllers, station equipment, storage batteries. Illustrative problems. *Prerequisites:* 323, 324. First and second terms (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. *Prerequisites:* 323, 326. Fee, $6. First and second terms (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 361 or 375. Advanced testing of direct current machines; practice in operating and testing alternating current apparatus. *Prerequisites:* 355, 354. Fee, $6. First and second terms (1).

357. Theory of Alternating Currents. The elementary principles of alternating currents. Lectures, recitations, and problem work. *Prerequisites:* 146, 147, 326, 352, 353. First term (3).

358. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. *Prerequisites:* 352, 353. Fee, $6. First term (1).

359. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. *Prerequisites:* 357, 358. Second term (2).

360. Electrical Engineering. Application of physical and mathematical principles to the analysis and solution of problems relating to direct and alternating current circuits and apparatus; transient phenomena; use of complex quantities; non-harmonic periodic wave forms. *Prerequisites:* 327, 357. Second term (3).

361. Electrical Engineering. A course particularly adapted to students who do not further specialize along electrical lines; systems of generation, transformation, distribution, and transmission of electrical energy by direct and alternating currents; the application of electric motors to various industries; overhead and underground construction; estimates and costs. *Prerequisites:* 354, 355, 375. Second term (2).

362. Dynamo Laboratory. Continuation of 356 or 358. Advanced testing of direct current machines. Alternating current testing begun. *Prerequisites:* 357, 358. Fee, $6. Second term (1).

363. Alternating Current Machinery. Study of the structural details, characteristics, and operation of alternators, alternating current motors, rotary converters, and transformers; application of vectors. *Prerequisites:* 327, 359, 360. First term (4).

364. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors, and motor generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. *Prerequisites:* 327, 357, 358. Second term (1).

365. Dynamo Testing. Continuation of 364. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. *Prerequisites:* 359, 362, 364. First term (1).

366. Dynamo Laboratory. Advanced experimental studies and tests of direct and alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. *Prerequisites:* 359, 360, 362, 364. Fee, $12. First term (3).

367. Electrical Design. Application of electric, magnetic, and mechanical principles to the design of electromagnetic mechanisms, direct current generators, and motors; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. *Prerequisites:* 327, 359, 360, 362. First term (2).

368. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxiliary

machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; sub-stations; operation and management; visits to neighboring plants. *Prerequisites:* 170a, 222, 359, 362. First term (2).

369. Electrical Engineering Seminar. A weekly meeting held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. *Prerequisites:* 357, 360, 362. First term (1).

370. Electrical Design. Continuation of 367. Application of electric, magnetic, and mechanical principles to the design of alternating current machinery and apparatus; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. *Prerequisites:* 363, 366, 367. Second term (2).

371. Electric Traction. Optional with 378. The construction, equipment, and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movements; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants and required reports. *Prerequisites:* 363, 368. Second term (3).

372. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining, and manufacturing work. Mathematical determination of line constants, regulation, interference, transients, etc. Switching and protection of circuits; metering and methods of charging for power; recent practice in design and construction of lines and systems. *Prerequisites:* 375 or 363, 368. Second term (3).

373. Electrical Engineering Seminar. Continuation of 369. Presentation and discussion of reports on thesis work. *Prerequisite:* 369. Second term (1).

374. Dynamo Laboratory. Continuation of 366. Advanced alternating current testing. *Prerequisites:* 363, 365, 366. Fee, $12. Second term (2).

375. Alternating Currents. A course following Course 354; the principles and practice of alternating current engineering; the theory of alternating currents with applications to alternating current generators, motors, transformers, and other apparatus; systems of transmission and distribution; electric lighting. *Prerequisite:* 354. First and second terms (2).

376. Summer Work. During the vacation following the sophomore and junior years each student in Electrical Engineering is required to spend at least eight weeks in getting practical experience at some approved shop or plant. A written report on the shop or plant, and the experience gained therein, is due September 17. These reports should contain such calculations, photographs, drawings, and plots as each individual case may require. Summer term (3).

377. Thesis for Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the senior year. The work upon which the thesis is based is done during the second term, and consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. *Prerequisites:* 363, 366. Second term (3).

378. Electrical Communication. Optional with 377. A survey of the methods of electrical communication, principles of various systems of wire telegraphy, wire telephony, radio telegraphy and telephony, radio laboratory measurements, radio practice of the U. S. Signal Corps. *Prerequisite:* 357 or 375. Fee, $6. Second term (3).

## CHEMISTRY

PROFESSORS ULLMANN AND BABASINIAN,
ASSOCIATE PROFESSORS DIEFENDERFER, CHAMBERLIN, AND LONG,
ASSISTANT PROFESSORS BECK, EWING, ANDERSON, OPDYCKE, AND SINKINSON, MESSRS. BUCKLEY, CANTELO, SHIREY, BILLINGER, AND SMULL

390. Elementary Chemistry. Elementary phenomena and principles of chemistry. Lectures illustrated by experiments,

diagrams, working drawings, and specimens from the museum. Note-books on the lectures required. Holmes' *General Chemistry.* First term (2).

391. CHEMISTRY LABORATORY. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Long, Chamberlin, and Buckley's *Experimental General Chemistry.* Deposit, $15. First term (2).

392. CHEMISTRY LABORATORY. For B.A. students. Shorter course. Deposit, $15. First term (1).

393. CHEMISTRY. A course for students who pass the examination in Elementary Chemistry held on the first Saturday of the term. Smith's *Intermediate Chemistry for Colleges. Prerequisite:* Satisfactory preparation in the rudiments of chemistry. First term (2).

393a. CHEMISTRY LABORATORY. Experiments designed to accompany 393. Long, Chamberlin, and Buckley's *Experimental General Chemistry. Prerequisite:* Satisfactory preparation in the rudiments of laboratory chemistry. Deposit, $15. First term (2).

394. CHEMISTRY. Continuation of 390 or 393. *Prerequisite:* 390 or 393. Second term (1).

395. QUALITATIVE ANALYSIS. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Baskerville and Curtman's *Qualitative Analysis. Prerequisites:* 390 and 391, or 393 and 393a. Deposit, $25. Second term (2) or (3).

396. QUALITATIVE ANALYSIS CONFERENCE. Special consideration of science underlying qualitative analysis. Treadwell's *Analytical Chemistry, Vol. I. Prerequisites:* 390 and 391, or 393 and 393a. Second term (1).

397. STOICHIOMETRY. Chemical problems and reactions. Long and Anderson's *Chemical Calculations. Prerequisites:* 390 and 391, or 393 and 393a. Second term (1).

398. ADVANCED CHEMISTRY. Lecture course, with recitations. Theories of chemistry; physical and chemical methods of determining atomic and molecular weights, thermo-chemistry, dissociation, solution, catalysis, electrolysis, radio-activity, non-metallic elements and their compounds. Mellor's *Modern Inorganic Chemistry. Prerequisites:* 390 and 391, or 393 and 393a; 395, 397. First term (3).

399. Advanced Chemistry. Lecture course, with recitations. Phase rule, solid solutions, metallic elements and their compounds. Readings in original literature. Mellor's *Modern Inorganic Chemistry,* Gulliver's *Metallic Alloys. Prerequisite:* 398. Second term (3).

400. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkilimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Treadwell's *Analytical Chemistry, Vol. II. Prerequisites:* 395, 396, 397. Deposit, $30. First term (3).

401. Quantitative Analysis. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. *Prerequisites:* 395, 397. Deposit, $25. First term (3).

402. Quantitative Analysis Conference. Lectures and recitations concerning the laboratory work of 400 and 401. *Prerequisites:* 395, 397; also 396 for B.S. in Chem. and Ch.E. First term (2) or (1).

403. Quantitative Analysis. Continuation of 401. *Prerequisite:* 401. Deposit, $30. Second term (3).

403a. Quantitative Analysis. Summer course arranged for students in Metallurgy. *Prerequisites:* 395, 396, 397. Deposit, $40. Summer term (3).

404. Quantitative Analysis. Continuation of 400. Analysis of minerals, ores, slags, alloys, electrolytic analysis, etc. Treadwell's *Analytical Chemistry, Vol. II. Prerequisite:* 400. Deposit, $30. Second term (2) or (3).

405. Quantitative Analysis Conference. Lectures and recitations concerning laboratory work of 403 and 404. *Prerequisites:* 400 or 401; 402. Second term (2) or (1).

406. Quantitative Analysis. Continuation of 404. Ores and alloys. Complete analysis of iron and steel; also gas analysis. Hillebrand's *Analysis of Silicate and Carbonate Rocks,* Lord and Demorest's *Notes on Metallurgical Analysis,* Hempel's *Gas Analysis. Prerequisite:* 404. Deposit, $25. First term (2).

407. Quantitative Analysis Conference. Discussions concerning the laboratory work of 406. *Prerequisite:* 405. First term (2) or (1).

408. Organic Chemistry. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Bernthsen's *Organic Chemistry,* translated by Sudborough. *Prerequisites:* 399, 403 or 404; 405; for Pre-medical students, 395, 397. First term (3).

409. Organic Chemistry Laboratory. Determinations of specific gravities, melting points, boiling points, vapor densities; qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. Preparation of pure organic compounds. Gattermann-Schober's *Practical Methods of Organic Chemistry,* Cohen's *Practical Organic Chemistry. Prerequisites:* The same as for 408. Deposit, $20. First term (2).

410. Organic Chemistry. Continuation of 408. Lectures and recitations. *Prerequisite:* 408. Second term (4).

411. Organic Chemistry Laboratory. Continuation of Course 409. Practical methods of saturation, nitration, reduction, diazotization, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Gattermann-Schober's *Practical Methods of Organic Chemistry,* Cohen's *Practical Organic Chemistry. Prerequisite:* 409. Deposit, $40. Second term (3) or (2).

411a. Advanced Organic Chemistry. *Prerequisites:* 408, 409, 410, 411, with high grades. First term (2).

412. Industrial Chemistry. Engineering fundamentals, including machinery and materials of chemical plants, transportation of gases, liquids and solids, grinding, pulverizing, screening, filtration, evaporation, distillation, etc. Laboratory work includes the application of these fundamentals, with reports on various problems of chemical engineering. *Prerequisites:* 406, 407, 408, 410. Deposit, $25. First term (3).

413. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, gold, and silver, and of gold and silver bullion. Cyanidization. Calculations for slag and slag mixtures. Lodge's *Notes on Assaying. Prerequisites:* 403 or 404; 405. Deposit, $30. Summer term, four weeks, beginning June 11, 1924 (3).

414. Assaying and Industrial Mineralogy. This covers much of the ground of 413. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about fifty minerals and rocks. It is intended primarily for students in Chemistry and Chemical Engineering. *Prerequisites:* 403 or 404; 405. Deposit, $30. Summer term, four weeks, beginning June 11, 1924, (3).

415. Industrial Chemistry. Continuation of 412. Lectures, problems, and inspection trips on chemical processes and industries. *Prerequisite:* 412. Second term (3).

416. Industrial Analysis. Analysis of commercial products. Laboratory work. Allen's *Commercial Organic Chemistry. Prerequisites:* 410, 411. Deposit, $10. Second term (3).

417. Industrial Analysis Conference. Lectures concerning the laboratory work of 416. *Prerequisites:* The same as for 416. Second term (1).

418. Sanitary Chemistry Laboratory. Qualitative and quantitative examination of drinking water and food-stuffs. *Prerequisites:* The same as for 416. Deposit, $15. Second term (1).

419. Physical Chemistry. Lectures and recitations. Lewis' *A System of Physical Chemistry. Prerequisites:* 147, 399, 403a; also 404, 405, 408, 409 for B.S. in Chem. and Ch.E. First term (3).

420. Physical Chemistry Laboratory. Physico-chemical measurements. Findlay's *Practical Physical Chemistry. Prerequisites:* The same as for 419. Deposit, $10. First term (1).

421. Physical Chemistry. Continuation of 419. *Prerequisite:* 419. Second term (2).

422. Physical Chemistry Laboratory. Continuation of 420. *Prerequisite:* 420. Deposit, $10. Second term (1).

423. Research Chemistry. Advanced stage of study or an investigation approved by the Professor of Chemistry of some novel problem, involving exhaustive laboratory and library study. *Prerequisite:* All lower chemistry. Deposit, $15. First term (2) or (3).

424. Research Chemistry Laboratory. Continuation of 423. *Prerequisite:* 423. Deposit, $15. Second term (2).

425. History of Chemistry. Chronological development of the science, with assigned reading. *Prerequisites:* 410, 411. Second term (1).

426. Electrochemistry. Chemical reactions in gases, solutions, and molten electrolytes caused by the electric current. Quantitative relations between electromotive force, electrical energy, and chemical energy. Efficiency and applicability of typical processes. *Allmand's Applied Electrochemistry* and incidental reading of references. *Prerequisites:* The same as for 419. First term (1).

427. Electrochemistry Laboratory. Experimental study of electrochemical reactions. Current efficiencies. Electromotive force measurements and overvoltage. Transport numbers. Electrochemical preparations. *Prerequisites:* The same as for 419. First term (1).

Deposits to cover breakage, chemicals, etc., are required as indicated above. The unused portion of the deposit is returned to the student.

Summer Schools. Assaying and Mineralogy (414) begins June 11, 1924. Summer courses are open to all persons prepared to take them.

## MARINE ENGINEERING AND TRANSPORTATION

PROFESSOR CHAPMAN, MR. NOYES

450. Ship Construction. An introductory course treating the various types of ships and methods of constructing steel and wooden ships. First term (2).

451. Ship Construction. A continuation of Course 450, taking up details of ship construction, bow and stern construction, and special types of construction. During the course the student fairs a set of ship's lines. *Prerequisite:* 163. Second term (4).

452. Naval Architecture. Displacement, stability, trim, launching, and strength of ships. The course is illustrated by numerous practical problems, and the student makes displacement and stability calculations by means of the integrator. *Prerequisite:* 147. First term (3).

453. Naval Architecture. Resistance, powering, and propulsion; steering and maneuvering; and rolling of ships. A study

is made of the effect of size, form and coefficients on the speed and power of ships; appendage resistance, models and model tanks; powering of paralleled bodied ships; propeller design and the influence of the hull on the action of the propeller. The work in rolling takes up a mathematical investigation of the rolling of ships in still water and among waves. Taylor's *Speed and Power of Ships. Prerequisite:* 452. Second term (4).

454. Marine Engineering. The marine power plant and the layout of machinery on shipboard. Boilers, reciprocating steam engines, turbines, combination machinery, electric drive, and Diesel engines; fuels, combustion, draft and draft apparatus; condensing apparatus and ship auxiliaries. Chapman's *The Marine Power Plant. Prerequisite:* 218. Second term (4).

455. Ship Design. Lectures and drawing-room work. In this course and Course 456 each student carries through a design for assigned requirements which parallels the class room work. In this design he works up the dimensions, coefficients, displacement, estimated weights; stability under various conditions of loading; power and propeller requirements; accommodations and arrangement plans; freeboard, and bulkhead subdivisions; and cargo handling arrangements. Lectures covering the design of boats for inland water navigation. *Prerequisites:* 450 to 454. First term (3).

456. Ship Design. A completion of the work of Course 455. Lectures covering tonnage, yacht design, piping systems, maintenance, repairs, heating, and ventilation. In the drawing room the student draws up a set of lines and makes a machinery layout. *Prerequisite:* 455. Second term (3).

457. Terminal Facilities. A study of the loading and unloading of ships, cranes, piers, transit sheds, warehouses and railroad facilities, and the other factors involving a quick "turn-around" of a ship in port. MacElwee's *Ports and Terminal Facilities. Prerequisite:* Junior standing. First term (2).

458. Summer Work in Ship Construction and Marine Transportation. During the summer following the sophomore and junior years, students are required to spend at least eight weeks in a shipyard or at sea. (3).

459. Ship Operation. A study of the engineering aspects of ship operation. The relation of size and speed of ships for the most economical performance in service; a study of the operating expenses of ships with different types of propelling machinery on various trade routes; influence of stevedoring costs and turn-around on profits; comparison of operating expenses of the steamship and the motor ship. Numerous practical problems. *Prerequisites:* 454 and 455. Second term (2).

460. Marine Engineering. A detail study of Diesel engines, Diesel auxiliaries; steam auxiliaries and evaporator plants. During this course the student carries through calculations for the auxiliaries for an assigned ship. *Prerequisites:* 218, 454 or 209. First term (3).

## MILITARY SCIENCE AND TACTICS

MAJOR PATCH, CAPTAINS CHANCE AND BELL, LIEUTENANTS GRAHAM AND BOYDEN, AND SERGEANTS MADDEN, BOYLE, AND LAVIN

An infantry unit of the Reserve Officers' Training Corps was established at Lehigh University in September, 1919. Conducted on a voluntary basis during the year 1919-1920, the unit had a membership of 313 students. A year later the Trustees and Faculty of the University made Military Science and Tactics a required subject, under the R. O. T. C. regulations, for physically fit freshmen and sophomores. Provision for this training is made in their schedule of study.

The military courses contemplated under the War Department regulations consist of two years of basic work and two years of elective advanced work along specialized lines. A student taking the courses for four years becomes eligible, upon graduation, for a commission in the Officers' Reserve Corps of the United States Army. Uniform and equipment, consisting of cap, coat, shirt, breeches, leggins, rifle, belt, and bayonet, are furnished by the Government. Musical instruments are also furnished to the members of the band. Each student having in his possession any goverment property is required to execute a bond for $50. During the advanced course students are paid commutation of subsistence, amounting to approximately $10 a month.

470. Basic Course. Fundamental military training common to all arms of the service. Three hours a week, two theoretical and one practical. Theoretical instruction consisting of lectures, recitations, and quizzes on organization, infantry drill regulations, rifle marksmanship, scouting and patrolling, physical training, and military courtesy. Practical instruction given in infantry drill, rifle marksmanship, and ceremonies. First and second terms (1½).

470a. R. O. T. C. Basic Camp of six weeks, with report, for engineering students, except Naval Engineers. (Optional.) (3).

471. Basic Course. Second year. Three hours a week. Fundamental military training common to all arms. Fundamentals of map reading and military sketching, military hygiene, musketry, sanitation and first aid, command and leadership, automatic rifle, bayonet, and grenades. First and second terms (1½).

472. Advanced Course. Third year. Five hours a week. Field engineering, 37 mm. gun, light (Stokes) mortar, machine guns, military law, rules of land warfare, command and leadership, drill, marches, concealment and camouflage. First and second terms (3½).

472a. Summer R. O. T. C. Advanced Camp. Compulsory for students who elect the advanced course (3).

473. Advanced Course. Fourth year. Five hours a week. Infantry drill, tactics, tactical walks, war games, military history of the United States, command and leadership, pistol marksmanship, interior economy, and administration. First and second terms (3½).

Ample facilities for close order drill are afforded on the upper athletic field. A twelve target, fifty and seventy-five foot, indoor range is located in the cage. A five target, fifty-foot range is located in Packer Hall basement. Intercollegiate team matches and intramural team matches are held indoors from December 1 to May 1.

## PHYSICAL EDUCATION

PROFESSOR REITER, ASSOCIATE PROFESSOR BALDWIN,
ASSISTANT PROFESSOR BARTLETT, MR. KANALY

The aim of the Department of Physical Education is to insure the health and physical development of every student of the University. Facilities for accomplishing this aim are afforded in Taylor Gymnasium, the field house, and the two playing levels of Taylor Field.

Each student, upon entering the University, is given a physical examination. He is advised as to postural and physical defects.

All students are required to take regular exercise under Department supervision. This requirement calls for two hours a week in the gymnasium, or participation, under the oversight of the Director, in one of the following organized sports: football, cross country running, basketball, wrestling, swimming, soccer, track, lacrosse, tennis, and baseball. In addition numerous intramural contests are held. All students are urged and encouraged to participate in these activities. Members of the R. O. T. C. unit may substitute one hour of military drill for one of the two hours of required gymnasium.

500. GYMNASIUM. Class exercise in the open air, consisting of setting-up work for current carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, and muscular action and to produce co-ordination and grace. Squad work on the heavy apparatus to develop strength in the larger muscles, recreative work in games and competitive exercises to develop the play and combative elements. The various drills and athletic dances are accompanied by music. Instruction in boxing, wrestling, swimming, fencing, golf, and personal defense. Corrective gymnastics are also given to those who have physical defects. The swimming course includes the various swimming strokes, fancy diving, and modern methods of life saving. A competent instructor is in charge. The measure of proficiency required of every student is swimming at least the length of the pool. Voluntary classes in advanced apparatus work. Talks are given to the freshmen on personal hygiene and the physiology of exercise. First and second terms; for freshmen and sophomores, (½); for juniors, seniors, graduate students (1).

## GRADUATE COURSES

Courses leading to the degree of Master of Arts or Master of Science may, by permission of the Faculty, be pursued by any properly qualified person who has taken the Bachelor's degree or a degree in technology at any recognized college, university, or technical institution, subject to the following regulations:

(1) All work which is to be credited toward a master's degree shall be done in actual and regular attendance at the University.

(2) A minimum of 30 term hours is required.

(3) At least 18 of the required 30 term hours must be taken in one department. The remaining twelve hours will ordinarily be taken in one or two other departments; but the entire 30 hours may, with the approval of the Committee on Graduate Studies, be taken in a single department. In all cases, however, the work must be taken under at least two different instructors.

(4) A thesis may be required by the major department. If required, the thesis shall not count for more than 10 credit hours. Two bound typewritten copies of the thesis (one of which shall be an original copy) shall be submitted to the Faculty on or before May 15 of the year in which the degree is conferred.

(5) The Master's degree will not be granted unless the candidate has earned the grade A or B in at least three-fifths of his work. No course in which the grade earned is less than C will count towards the degree.

(6) Candidates employed as full-time teachers in the University or elsewhere may not take more than six hours of graduate work in any one semester.

(7) Tuition for graduate work will be charged on the basis of five dollars ($5.00) per term hour.

When all requirements have been met, the candidate will be recommended by the Faculty to the Trustees for the Master's degree appropriate to the course pursued.

Some of the University Extension Courses listed on page 142 are designated as graduate courses. As these are given late in the afternoon, or in the evening, or on Saturdays, they are especially adapted to teachers.

The following graduate courses are now offered by the University:

## PHILOSOPHY, PSYCHOLOGY, AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

The following is the course that commonly is followed by those who select Education as the major study: Educational Psychology, 4 hours; School Administration, 4 hours; Secondary Education, 4 hours; Seminar in Education, with Thesis, 8 hours.

1. History of Philosophy, Advanced course. (6)
2. Plato. More's Platonism and the religion of Plato. (2)
3. The Philosophy of History. Augustine, Kant, Hegel, Comte, Spencer, Croce. The economic interpretation of history. The meaning of evolution. (4)
4. Spinoza. (2)
5. Thesis in Philosophy. (2 to 8)
6. Educational Psychology. (2 to 6)
7. Social Psychology. (2 or 4)
8. Educational Measurements. (2 or 4)
9. Secondary Education. (2 or 4)
10. School Administration: State and County. (2)
11. School Administration: City. (2)
12. Educational Sociology. (2)
13. The Junior High School. (2)
14. Curriculum Making. (2)
15. The Project Method. (2)
16. Seminar and Thesis in Education. (2 to 5)
17. History of Education. (4)

## ECONOMICS AND HISTORY

PROFESSOR CAROTHERS, ASSISTANT PROFESSOR BROWN

Finance. A graduate course in advanced finance, with special reference to the development of banking under the Federal Reserve system. Students will be required to do a considerable amount of assigned reading, to prepare special assignments for class room discussion, and to write reports on certain phases of the work. Two terms (3).

United States History. A graduate course in United States History, with special emphasis on the constitutional, political, and social aspects. The work will consist of class room discussion, assigned readings, and written reports. Two terms (3).

## LATIN

PROFESSOR WRIGHT

An advanced course in the Latin language and literature or in one of the branches of Roman antiquities, arranged with each candidate individually on application. Two terms (5).

## GREEK

PROFESSOR GOODWIN

Advanced courses, of which the following are specimens, will be arranged upon application:

Hellenistic Greek. Portions of the *Gospels* in a comparative study, the *Acts,* and selected *Epistles.* Thayer's *Lexicon.* Blass's *Grammar of New Testament Greek.* Patristic literature. Collateral reading. Selections from Lucian.

Dramatic Poetry. Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's *Poetics.* Collateral reading.

Greek Philosophy. Plato's *Republic* and other works. Aristotle, selections. Ritter and Preller's *Historia Philosophiae Graecae.* Zeller's *History of Greek Philosophy,* and other collateral reading.

## GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

The German Drama of the Nineteenth Century. First and second terms (3).

Lessing as Dramatist and Critic. First and second terms (3).

Middle High German. Wright's *Middle High German Primer,* Bachmann's *Mittelhochdeutsches Lesebuch, Nibelungenlied.* First term (3).

MIDDLE HIGH GERMAN. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walter von der Vogelweide. Lectures on Middle High German literature. Second term (3).

## ROMANCE LANGUAGES

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

THE REALISTIC NOVEL IN FRANCE. Novels of Flaubert, Balzac, de Goncourt, de Maupassant, Daudet, Zola, Mérimée. Reading and written reports on all books read. Lectures and discussion on the origin and development of the novel in France. The theory of Realism and Naturalism. Two terms (3).

OLD FRENCH. Grammar. Schwan-Behrens. Easier texts. *Chanson de Roland.* Two terms (3).

OLD PROVENCAL. Reading and explanation of texts. Grammar; Grandgent. *Chrestomathie; Appel.* First and second terms (1).

ROMANCE PHILOLOGY. Sound change. Word formation. First or second term (2) or (3).

ROMANCE PHILOLOGY. Syntax. First or second term (2) or (3).

THE MODERN SPANISH NOVEL. Works of Galdós, Alarcón, Valera, Pereda, Valdés, Pardo Bazan, Ibáñez, Valle Inclan, Baroja. Reading, reports, and lectures. Two terms (3).

OLD SPANISH. Ford's *Old Spanish Readings.* First or second term (1).

DANTE. *Inferno.* Lectures and outside reading. First or second term (2) or (3).

## ENGLISH

PROFESSORS THAYER AND LUCH, ASSISTANT PROFESSOR MESCHTER

ENGLISH LITERATURE. An advanced course in branches which have not formed a part of the undergraduate work of the candidate, details to be arranged after a personal conference. Two terms (5). Professor THAYER.

ANGLO-SAXON. Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical points of view. Two terms (5). Assistant Professor MESCHTER.

ENGLISH PHILOLOGY. An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5). Professor LUCH.

MODERN POETRY. Poetry of the Twentieth Century, matter, metre, and diction. Present tendencies. One term (5). Assistant Professor MESCHTER.

SANSKRIT. Beginner's Course. Perry's *Primer*. Lanman's *Reader*. Whitney's *Grammar*. Two terms (5). Professor THAYER.

## MATHEMATICS AND ASTRONOMY

PROFESSORS THORNBURG, LAMBERT, OGBURN; ASSOCIATE PROFESSORS STOCKER AND REYNOLDS; ASSISTANT PROFESSOR KNEBELMAN

PRACTICAL ASTRONOMY. The study of instruments and methods used in the determination of time, latitude, longitude, and azimuth; practical work in the observatory, to give facility in making and reducing observations. Two terms (5). Professors THORNBURG and OGBURN. *Prerequisites:* 141, 142, 147, 150.

DIFFERENTIAL EQUATIONS. Based on Johnson's *Differential Equations and* Byerly's *Spherical Harmonics*. Collateral reading in the University Library. *Prerequisites:* 145, 146, 147. Two terms (3). Professor LAMBERT.

ANALYTIC MECHANICS. Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's *Theoretical Mechanics;* Williamson and Tarleton's *Dynamics;* and Routh's *Dynamics*. *Prerequisites:* 146, 147, 148, 149. Two terms (3). Associate Professor REYNOLDS.

DIFFERENTIAL GEOMETRY. Parametric representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, intrinsic equations, trajectories, equations of Césaro, curvilinear coordinates, equations of Lamé. Representation of one plane upon another, conformal and spherical representation, equations of Gauss and Godazzi, theory of applicability. *Prerequisites:* 146, 147, 148. Two terms (2). Assistant Professor KNEBELMAN.

THEORY OF EQUATIONS. An elementary and advanced course in Theory of Equations, based on the treatise by Burnside and Panton. *Prerequisites:* 143, 144. Two terms (2). Associate Professor STOCKER.

INTEGRAL CALCULUS. A course in advanced Integral Calculus, including Elliptic Integrals, based on the works of Byerly and Williamson. *Prerequisites:* 146, 147, 148. Two terms (2). Associate Professor STOCKER.

VECTOR ANALYSIS. A course in the Theory and Methods of Vector Analysis as applied in physics and pure mathematics. *Prerequisites:* 146, 147. Two terms (2). Associate Professor REYNOLDS.

## CIVIL ENGINEERING

PROFESSORS FOGG AND WILSON, ASSOCIATE PROFESSOR FULLER, ASSISTANT PROFESSOR PAYROW

BRIDGE DESIGN. The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4). Professor FOGG.

TESTING OF MATERIALS. The properties of materials of construction, with special reference to inspection and testing. Original researches by the student in the laboratory. Detailed attention to the work on the unification of methods of testing done by the International Association for Testing Materials. Two terms (5). Professor FOGG, Associate Professor FULLER.

RAILROAD ENGINEERING. The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with discussion of special cases. Two terms (2). Professor WILSON.

SANITARY AND HYDRAULIC ENGINEERING. The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4). Assistant Professor PAYROW.

## METALLURGY

PROFESSOR STOUGHTON, ASSOCIATE PROFESSOR ROUSH, ASSISTANT PROFESSOR BUTTS

PROCESS IRON AND STEEL METALLURGY. Literary research followed by laboratory or plant investigations (or both) on improvements or innovations in the production, purification, or super-

refining of iron and steel. Conferences and laboratory investigations. First and second terms (5) or (10). Professor STOUGHTON.

PHYSICAL IRON AND STEEL METALLURGY, HEAT TREATMENT, AND METALLOGRAPHY. Literary research followed by laboratory investigations on improvements in the physical properties of iron and steel or any of their alloys, or on methods of determining the physical properties. Conferences and laboratory investigations. First and second terms (5) or (10). Professor STOUGHTON.

MECHANICAL IRON AND STEEL METALLURGY. Literary research followed by laboratory or plant investigations (or both) on adapting or conforming the size and shape of iron or steel to the needs of industry. Conferences and laboratory investigations. First and second terms (5) or (10). Professor STOUGHTON.

PROCESS NON-FERROUS METALLURGY. Literary research followed by laboratory or plant investigations (or both) on improvements or innovations in the production, purification, or super-refining of non-ferrous metals or their alloys. Conferences and laboratory investigations. First and second terms (5) or (10). Associate Professor ROUSH.

PHYSICAL NON-FERROUS METALLURGY AND METALLOGRAPHY. Literary research followed by laboratory investigations on improvements in the physical properties of non-ferrous metals or any of their alloys, or on methods of determining the physical properties. Conferences and laboratory investigations. First and second terms (5) or (10). Professor STOUGHTON, Assistant Professor BUTTS.

MECHANICAL NON-FERROUS METALLURGY. Literary research followed by laboratory or plant investigations (or both) on adapting or conforming the size and shape of non-ferrous metals or their alloys to the needs of industry. Conferences and laboratory investigations. First and second terms (5) or (10). Professor STOUGHTON, Assistant Professor BUTTS.

ELECTROMETALLURGY. A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5). Associate Professor ROUSH.

METALLURGICAL CONSTANTS. Study and determination of the melting points, vapor tensions, specific heats, and latent heats of fusion and of vaporization of metals, or alloys, from practical and theoretical viewpoints. The application of these and other thermo-chemical and thermo-dynamical constants of metals in quantitative metallurgical calculations. Conferences and laboratory investigations. First and second terms (5). Assistant Professor BUTTS.

## GEOLOGY

PROFESSOR MILLER,
ASSISTANT PROFESSORS TURNER AND FRETZ

GEOLOGICAL INVESTIGATION. The investigation and study of the literature of some special geological problem. Field and laboratory work on some district; map of a limited area; an investigation of the microscopic character and general structural features of the rocks which are exposed; presentation of a thesis or dissertation embodying these results. Preparation required dependent upon the nature of the problems to be studied. Two terms (4). Professor MILLER.

ECONOMIC GEOLOGY. Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some of the metallic or non-metallic minerals. Thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. *Prerequisites:* 270 or 271. Two terms (6). Professor MILLER.

PETROGRAPHY. A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. *Prerequisites:* 266, 268, 269, 276. Second term (3). Assistant Professor TURNER.

PHYSIOGRAPHY. The detailed study of physiographic types and processes. Conferences, reports, and thesis, with work in the laboratory and field. Training in elementary physiography and general geology required as a prerequisite. Two terms (4). Professor MILLER.

Physical Crystallography. An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4). Assistant Professors Turner and Fretz.

## BIOLOGY

PROFESSOR HALL,* ASSOCIATE PROFESSOR THOMAS

Advanced courses, of graduate grade, may be arranged in comparative anatomy, vertebrate embryology, and bacteriology. Other courses, covering such subjects as the history of biology, genetics, etc., which do not involve laboratory work, may also be arranged.

Vertebrate Histogenesis and Organology. Careful following, in the laboratory, of the development of a vertebrate, tracing of the history of the germ-layers, organs, and tissues. Organology dealing with the association of tissues to form organs. *Prerequisites:* 292, 293, 294. First term (3).

## MINING ENGINEERING

PROFESSOR ECKFELDT, ASSOCIATE PROFESSOR BARTLETT

Methods of Mining. The study of methods used in a given mining region, or in the production of a given class of material, with respect to conditions influencing choice of method and cost. Two terms (5). Professor Eckfeldt.

Mining Plant. The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5). Professor Eckfeldt.

Ore-Dressing Plant. The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressings. Two terms (5). Associate Professor Bartlett.

## PHYSICS

PROFESSOR MAC NUTT,

ASSOCIATE PROFESSOR FRY, ASSISTANT PROFESSOR KLEIN

Heat and Thermodynamics. The aim of this course is to present a comprehensive account of the Science of Heat and to develop the consequences of the two fundamental laws of Thermodynamics. First and second terms (3) to (5).

* On leave of absence, 1923-4.

THE THEORY OF ELECTRICITY AND MAGNETISM. An introductory discussion of the theorems in electrostatics of Gauss, Poisson, Laplace, and their application. Maxwell's theory of the electro magnetic field and electro magnetic waves followed by the Electron Theory of Lorenz as applied to Electricity and Magnetism. First and second terms (3) to (5).

THE THEORY OF LIGHT. A course covering the more important sections of geometrical and physical optics. First and second terms (3).

ELECTRON THEORY AND ATOMIC STRUCTURE. A study of the properties of the electron; wave and quantum theories of radiation and the structure of the atom. First and second terms (3).

PHYSICAL RESEARCH. Opportunity is afforded advanced students to pursue experimental investigations in physics. First and second terms (2) to (4).

## ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

THEORY OF ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. A course based upon the works of Arnold, Bedell, and Crehore, Fleming, Steinmetz, and Lawrence. Two terms (4). Professor ESTY.

ELECTRICAL DESIGN. A course consisting of predeterminations by calculation of the characteristics, regulations, and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3). Professor ESTY.

ELECTRIC TRACTION. The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of costs. Two terms (3). Professor ESTY.

ELECTRICAL TESTING. Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing Two terms (3). Professor ESTY, Associate Professor SEYFERT.

Radio Communication. The theory underlying the various sending and receiving systems, and the propagation of electromagnetic waves, combined with experimental work in connection with the department's wireless equipment. Two terms (2). Associate Professor Seyfert.

## CHEMISTRY

PROFESSORS ULLMANN AND BABASINIAN,

ASSOCIATE PROFESSORS DIEFENDERFER, CHAMBERLIN,* AND LONG,

ASSISTANT PROFESSORS EWING, OPDYCKE, AND SINKINSON

Industrial Chemistry. Investigation of a problem in chemical engineering or in industrial chemistry (4). Professor Ullmann, Associate Professor Chamberlin.

Quantitative Analysis. Investigation of a problem in analytical chemistry (4). Professor Ullman, Associate Professor Diefenderfer.

Advanced Organic Chemistry. An advanced course in certain theories of organic chemistry. First term (2). Professor Babasinian.

Chemistry of Drugs, Dyes, and Related Compounds. First term (2). Omitted in 1924-5. Professor Babasinian.

Advanced Organic Preparations. Mainly a laboratory course. First and second terms (2). Professor Babasinian.

Organic Chemistry Research. Investigation of a problem in organic chemistry (4). Professor Babasinian.

Advanced Inorganic Chemistry (2). Associate Professor Long.

Colloid Chemistry (2). Given in alternate years; omitted in 1924-5. Associate Professor Long.

Physical Chemistry Methods. Advanced methods of physical chemistry laboratory practice (2). Assistant Professor Ewing.

Physical Chemistry Research. Investigation of a problem in physical chemistry (4). Assistant Professor Ewing.

Theoretical Chemistry: Kinetics (2). Given in alternate years. *Prerequisites:* A good working knowledge of mathematics

* On leave of absence, 1923-4.

and the equivalent of undergraduate courses 419, 420, 421, 422. Assistant Professor OPDYCKE.

THEORETICAL CHEMISTRY: THERMODYNAMICS (2). Given in alternate years; omitted in 1924-5. *Prerequisites:* A good working knowledge of mathematics and the equivalent of undergraduate courses 419, 420, 421, 422. Assistant Professor OPDYCKE.

FUEL CHEMISTRY. Theoretical aspects and practice in the utilization of fuel, with the incidental methods of laboratory investigation (2). Assistant Professor SINKINSON.

FUEL CHEMISTRY RESEARCH. Investigation of a problem in the chemistry of coal (4). Assistant Professor SINKINSON.

The propriety of offering undergraduate courses in this department as a minor subsidiary to other courses will be adjudged in each case by the Department of Chemistry. The following undergraduate courses are sometimes accepted as minor subjects: Organic Chemistry of the junior year in the undergraduate curriculum, and the chemistry subjects of the senior year.

## MARINE ENGINEERING

PROFESSOR CHAPMAN

ADVANCED SHIP DESIGN. Advanced work in the design of cargo and passenger ships. The relation of size and speed of ships for the most economical performance in service; a study from actual layouts of the relative merits of various types of propelling machinery; sub-division and flooding calculations according to the rules of the Bulkhead Committee of the Board of Trade. The design of special types of ships and sailing yachts. Two terms (5). Professor CHAPMAN.

THE POWERING AND PROPULSION OF SHIPS. An advanced course consisting of a study of powering and propeller data and a comparison of the work of various investigators. Two terms (2). Professor CHAPMAN.

THE STRENGTH OF SHIPS. Investigation of the stresses set up in a ship's structure with particular application to special types of construction. Two terms (3). Professors FOGG and CHAPMAN.

## EXTENSION COURSES

Provision has been made for the admission of extension students to courses offered upon the University campus on Saturdays. These courses are intended primarily for graduate students who are engaged in teaching on the other days of the week. During the past year the following courses have been given:

Secondary Education. Assistant Professor Drown.
Educational Measurements. Assistant Professor Drown.
School Administration. Assistant Professor Drown.
Educational Psychology. Professor Hughes.
General Biology. Associate Professor Thomas.
Embryology. Associate Professor Thomas.
Comparative Anatomy. Associate Professor Thomas.
Bacteriology. Associate Professor Thomas.

In addition, the following courses have been given in Bethlehem, at the request of teachers in the public schools:

Elementary German. Professor Palmer.
The Novel. Professor Luch.
Educational Dramatics. Professor Luch.
Physiology and Hygiene. Professor Thomas.

At the request of a suitable number of applicants who are prepared for the work, the University will give such extension courses in Bethlehem as can be given without sacrifice of the time and energy that are demanded for the instruction of matriculated students in the University.

Graduates of any first-class high school, either men or women, are admitted to these extension courses. The fee is $7.50 per credit hour. Extension course certificates are issued to those who complete any course, and the records of all work completed are kept for reference in the University files.

### THE SUMMER SESSION EXTENSION COURSES

During the summer of 1923 the following extension courses were given:

Mental Diagnosis. 4 term hours. Professor Hughes.
Elementary Education. 3 term hours. Professor Hughes.

These courses commenced July 25 and continued seven weeks.

Hereafter the extension courses will be merged in the regular summer session of the University.

## EVENING SCHOOL OF BUSINESS ADMINISTRATION

The Lehigh University Evening School of Business Administration was organized in the fall of 1920 for business men in the vicinity of the University who desire a knowledge of the fundamental principles underlying business enterprise. A three-year course is offered. Instruction is given three evenings a week, from 7.40 to 9.40 o'clock, by members of the teaching staff of the College of Business Administration.

Upon completing a course a student receives a certificate of proficiency. If he later enters the College of Business Administration, his Evening School credits will be accepted on an hour-for-hour basis.

The subjects of the Evening School of Business Administration are as follows:

*First Year*

Business Law 1. Contracts and Negotiable Instruments. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; principal and agent; master and servant; negotiable instruments.

Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis upon the Federal Reserve Act.

Accounting. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problems involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. Emphasis on the economy aspects of accounting.

Economics. Lectures on economics, supplementing the other work of the school; optional.

*Second Year*

Business Finance (2 years). An exposition of the essential principles of sound financing; the different forms of financial organization; stocks and bonds; sale of securities, promotion and underwriting; financial management and irregularities and mismanagement.

Corporation Accounting. The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporation statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work. Problems selected largely from examinations for Certified Public Accountants.

*Third Year*

(Three subjects to be chosen)

Auditing
Manufacturing Accounts
Industrial Administration
Economics
Law
Investments
Government Regulation of Business
Advertising
Foreign Trade
Insurance

A circular giving entrance requirements, fees, and other details may be obtained by addressing the Dean of Lehigh University.

## BUILDINGS AND GROUNDS

The University occupies nineteen buildings, and its grounds cover 180 acres on the north side of South Mountain, overlooking the valley of the Lehigh River and the city of Bethlehem.

### PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture.

The Department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor

are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices, and a library room. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables, and other instruments for engineering field work. In the library room is a collection of plans of engineering structures. On the second floor are two drawing-rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the Department of Mathematics and Astronomy.

In the basement are located the store rooms and gallery range of the Department of Military Science and Tactics.

The offices of the President, Vice-President, and Dean are on the second floor of Packer Hall.

### THE WILLIAM H. CHANDLER CHEMICAL LABORATORY

The Chemical and Metallurgical Laboratories are contained in a fire-proof sandstone building, 259 feet in length by 44 in width, with two wings, each 62 feet in length by 42 feet in width.

In the Chemical department there are two principal stories, a basement, and a topmost story given over to the laboratory for physical chemistry. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for research chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic chemistry and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well-appointed laboratory for gas analysis; also rooms containing the apparatus for processes in industrial chemistry, steam engine and dynamo and motor installation, air pump for pressure and vacuum filtration, etc.

The University has recently completed an extension of the Chemical Laboratory. It is three stories high, in architectural conformity with the main building, and has inside dimensions

of 60 feet by 37 feet. The equipment of these laboratories is of the most modern type, and every accessory to comfort and efficiency in expediting laboratory work is provided.

The Metallurgical department contains a lecture room; a museum of metallurgical collections; an extensive departmental library; a dark room for photographic work; a laboratory provided with a spectroscope, two Le Chatelier and one Leitz metallographic microscopes complete with camera; a dry laboratory provided with gas and electric furnaces, and electric current for electrometallurgical experiments. Equipment is provided for laboratory work in metallurgy, metallography, and particularly in electrometallurgy, consisting of gas, electric current, and apparatus for various kinds of experimental work. Several new pyrometers, calorimeters, and furnaces have been added recently to the general equipment. This department is therefore equipped for the instruction of classes in metallurgy and electrometallurgy of the regular curriculum, to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallurgy and electrometallurgy, and for conducting original investigation in these departments of science.

The Trustees of the University named this building the William H. Chandler Chemical Laboratory in recognition of Dr. Chandler's thirty-five years' service as Professor of Chemistry, 1871-1906.

### THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics Department, the senior and junior dynamo laboratories, the shop and research room of the Electrical Engineering Department, and a storage battery room belonging jointly to the Departments of Physics and Electrical Engineering.

The dynamo laboratory for senior students in the west wing is supplied with power from a 75-kilowatt rotary converter

receiving current from the University power plant through two 30-kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four polyphase induction motors ranging from 2-horse power to 7½-horse power, three types of single-phase induction motors, two single-phase commutator motors, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, a Crane lecture room oscillograph, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the Departments of Physics and of Electrical Engineering, two general apparatus rooms, a large laboratory room for Physics, the Library of the Department of Physics and a small research laboratory, a large dynamo laboratory for sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo

laboratory for sophomore students in the west wing is equipped with twenty-seven direct current machines of various types, dynamotors, and several types of automatic starters and auxiliary apparatus. Apparatus exemplifying the operation of telegraph, telephone, and radio telegraph and telephone stations are here installed. The equipment in radio telegraphy and telephony includes a 250-foot antenna, 5-kilowatt transformer, oscillation transformer, a 3000-volt direct current generator, quenched gap, and several sets of receiving apparatus.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the Department of Physics, and the lecture room, recitation rooms, apparatus room, and radio laboratory of the Department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the Department of Physics.

### THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The W. A. Wilbur Engineering Laboratory was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two water-tube boilers rated at about 100-horse power each, one of Babcock & Wilcox, the other of Sterling type. In the heat and light plant there are three 250-horse power Sterling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevators is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse airbrake apparatus, with four freight car brakes. The airbrake pump and all the other small motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150- and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing gases, indicators, thermometers, steam calorimeters, and other instruments, and for experiments on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50- and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam may be discharged directly into the low-pressure system during the heating season.

A floor space of 45 feet by 70 feet in the old boiler house is now used as a laboratory. It contains a 150-horse power suction gas producer for anthracite coal and apparatus for gas-power engineering and hydraulics, and for minor thermodynamic experiments with steam.

This building bears the name of Mr. W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

## WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, Jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important service to the University as an alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the Department of Mechanical Engineering and the other half to the Departments of Geology and Biology.

In the eastern end there are recitation rooms, instructors' offices, drawing rooms, reference library, and store-rooms of the Department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in mechanical engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the Department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities in the world. In the basement are the mineralogical laboratory, the blowpipe analysis laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections, On the third floor is a room fitted as an office and laboratory, containing a Goldschmidt two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor there are the drawing room and an office of the Mining Department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this Department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

### THE FRITZ ENGINEERING LABORATORY

The late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, gave to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected in 1910 under the personal supervision of Mr. Fritz. The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Mechanics of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, of 10-ton capacity, operated by electricity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal

testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse, and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps, and other apparatus for studying problems in hydraulics. The cement and concrete section has a large room for the making and testing of specimens and a room for the storage of materials.

### THE ECKLEY B. COXE MINING LABORATORY

The Eckley B. Coxe Mining Laboratory is a building of dressed sandstone 100 feet long by 75 feet deep, one story high in front with a raised floor in the rear.

Th main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a sampling laboratory; the east wing contains the office, a recitation room, and an instrument room. There is a locker and wash room in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pan, with the necessary apparatus, including grizzly, elevators, feeders, sand-pumps, settling tanks, dryers, and electric motors. The sampling laboratory contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, and a magnetic separator.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, permitting experimental studies and tests of individual machines or groups of machines, or of an entire process, as occasion may require. The entire plant is thus flexible and enables combinations of processes in order to determine the best method to pursue in the treatment of ores, by coarse and fine concentration, and also in the preparation of coals.

Owing to the prominence which flotation methods have assumed in ore concentration, a special department of the main laboratory has been equipped for this work, and several types of testing

machines have been installed, together with the necessary equipment of motors, air compressors, etc., for their operation.

The laboratory houses also the following equipment: large and small size Ingersoll-Rand rock drills, Stoper and Jackhammer drills, an Ingersoll-Rand pick machine for coal mining, a Water-Leyner rock drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill.

The laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of Eckley B. Coxe, who was universally recognized as a pioneer and a leader in the profession of mining engineering in this country, an active friend and valued Trustee of the University from its early days until his death. The Engineering and Mining Laboratories of Lehigh University, bearing the names of John Fritz and Eckley B. Coxe, record the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh.

### CHRISTMAS HALL

Christmas Hall has historic interest as the first building of Lehigh University. It was originally a church, which was purchased from the Moravian Congregation. In the earliest years of the University it contained a chapel, lecture rooms, and students' dormitory. After Packer Hall was completed in 1868, Christmas Hall and Saucon Hall were utilized as students' dormitories and mess hall up to 1885. For many years thereafter Christmas Hall was used by the Departments of Latin, Greek, and Modern Languages.

The building is now largely devoted to the Department of Military Science and Tactics.

The office and recitation room of the Department of Greek are on the second floor.

### SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the Department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

### COPPEE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the College of Arts and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics, and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, German, Romance Languages, and Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for elementary instruction and experimentation in the psychology of sense and movement. On the third floor is the seminar room of the College of Arts and Science, also a large room for the use of Accounting, and a Statistical Laboratory.

### SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an equatorial telescope by Alvin Clark, of six inches clear aperture and of eight feet focus; a zenith telescope, by Blunt; a superior astronomical clock, by William Bond & Son; a meridian circle; a prismatic sextant, by Pistor and Martins; an engineer's transit and a sextant, by Buff and Buff. Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, of Bethlehem.

#### Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture, equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre in 1903. Observations secured with this instrument are for the purpose of investigating the Variations of Latitude.

### THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

### THE UNIVERSITY LIBRARY

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial to his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular with a facade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior there is a reading room 40 by 50 feet, from which radiate bookcases extending from floor to ceiling; two galleries afford access to the upper cases. Shelf room is provided for one hundred and sixty thousand volumes. One hundred and fifty thousand volumes are now upon the shelves. The list of periodicals numbers about four hundred. The Library is open from 8 A.M. to 9 P.M., except on Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Persons pursuing systematic investigation in any study may be allowed the free use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when the books are issued.

#### The Eckley B. Coxe Memorial Library

In memory of Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets.

As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

### TAYLOR HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete dormitory situated in the University Park, south of Packer Hall. It accommodates 137 students. There are suites of three rooms (a study and two adjacent bedrooms), for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Mr. Charles L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a Trustee of the University. The rates for the suites of rooms are $100 or $120 a year for each occupant. The single rooms are $50, $65, or $80 a year.

### PRICE HALL

Price Hall furnishes dormitory accommodation for thirty-four students. It is named in honor of Dr. Henry R. Price, an alumnus of the University of the Class of 1870, President of the Board of Trustees.

Applications for rooms in the dormitories should be filed with the Bursar.

### DROWN MEMORIAL HALL

Drown Memorial Hall is a memorial to the late Thomas Messinger Drown, LL.D., president of the University from 1895 to 1904. The building was erected by his friends and the alumni of the University and is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the college publications, and the dramatic and musical organizations. It also accommodates the Supply Bureau conducted by the University, the purpose of which is to furnish books, stationery, and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

The office of the Bursar is in Drown Memorial Hall.

### THE COLLEGE COMMONS

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for 400 students. The present rates for table board are $30 for thirty consecutive days. Cafeteria service is also provided.

### TAYLOR GYMNASIUM AND FIELD HOUSE

In 1913, Mr. Charles L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a gymnasium and a field house.

Taylor Gymnasium is situated at the extreme east end of the grounds of the University, adjoining the athletic field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game room, 93 by 70 feet, used for basketball and wrestling. The game room is surrounded by a gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basketball and handball courts, fencing, boxing, and wrestling rooms, and locker rooms with accommodations for the entire student body.

The gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenics and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms is a swimming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

Adjoining the gymnasium and the stadium is the Taylor field house. It is two stories in height, and has dressing rooms, lockers, and shower baths for visiting and Lehigh teams, and also rooms for medical attention to athletes.

### TAYLOR FIELD

An athletic field of more than nine acres in area is provided by the University for the accommodation of students who participate in the various outdoor sports. The Stadium is located on

the north side, or lower level, and provides football and baseball fields. It is surrounded by concrete stands having a seating capacity for more than 12,000 spectators. On the upper level there are practice fields for football, baseball, lacrosse, and soccer; also a quarter mile track and a 220-yards straightaway, furnishing ample room for exercise by the entire student body. During the winter months a wooden outdoor running track, fourteen laps to the mile, is provided.

A cage with 60 by 120 feet floor space affords facilities for rifle practice, indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

### SAYRE PARK

A development of the mountain side of the University grounds was effected through the donation to the University in 1909 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as President of the Board of Trustees, and as Chairman of the Executive Committee of the Board, and his services to Lehigh were constant and great.

### THE ARBORETUM

The Arboretum is a tract of about eleven acres added in 1909 to the upper end of Sayre Park. It was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Arboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

### THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy, and Archæology.

The Metallurgical Cabinet contains specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are housed in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

## TUITION AND OTHER FEES

| | |
|---|---|
| Tuition, in all colleges of the University, per annum.... | $300.00 |
| Health Service Fee, per annum..... | 10.00 |
| Athletic Fee, per annum..... | 10.00 |
| *Total Annual Fees*..... | $320.00 |

The above-mentioned fees are payable as follows:

FIRST TERM

*(Payable on the Fall-Term Registration Days in September)*

| | |
|---|---|
| Three-fifths of the Annual Tuition..... | $180.00 |
| One-half the Annual Health Service Fee..... | 5.00 |
| The Athletic Fee, in full..... | 10.00 |
| *Total Fees, First Term*..... | $195.00 |

SECOND TERM*

*(Payable on the Spring-Term Registration Days in February)*

| | |
|---|---|
| Two-fifths of the Annual Tuition..... | $120.00 |
| One-half the Annual Health Service Fee..... | 5.00 |
| *Total Fees, Second Term*..... | $125.00 |

* Students entering or re-entering in the second term pay first term fees.

In addition, new students pay, once only, on admission, a Matriculation Fee of $5, and students graduating pay a Graduation Fee of $10.

There are also small laboratory fees or deposits in laboratory courses to cover the actual cost of laboratory supplies used up by the individual student and to provide for breakage of glassware and instruments. The amounts of these fees and deposits are given in the Description of Courses in connection with each laboratory course.

To be eligible for a degree from Lehigh University, a student must not only have completed all of the scholastic requirements for the degree, but he must have paid all University fees and, in addition, all bills for the rental of rooms in the dormitories, or for board at the Commons, or for damage to University property or equipment, or for any other indebtedness to the University; it being understood, however, that this regulation does not apply to any indebtedness for deferred tuition or for loans from trust funds administered by the University which are protected by properly executed notes approved by the Comptroller.

*Refunds.* If a student formally withdraws from the University after less than four weeks' attendance, he may apply for a refund of part of the tuition fee; but the amount thus refunded will in no case exceed one-half of the last instalment paid.

## EXPENSES

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $600 in addition to tuition. This includes attendance at the *required* summer schools.

The University dormitories accommodate 171 students. The charge for single rooms is $50, $65, or $80 a year; suites of three or four rooms rent at $100 or $120 for each occupant.

Students may obtain table board at the College Commons. The rate is $30 for thirty consecutive days. Numerous private householders in the city offer rooms and board at moderate prices.

Books, stationery, and drawing instruments may be purchased at low prices at the Students' Supply Bureau in Drown Hall.

# SCHOLARSHIPS, FELLOWSHIPS, AND PRIZES

## UNIVERSITY SCHOLARSHIPS

The Trustees of Lehigh University have established the following scholarships, effective September 1, 1923:

I. Twenty-four scholarships (six in each of the four classes) which provide free tuition.

1. Three freshman scholarships to be awarded to the best of the candidates, each of whom must have presented evidence that he was in the highest 10% of his class in scholarship in the high school or preparatory school from which he was graduated.

2. Three freshman scholarships to be awarded to the best of the candidates, each of whom must have presented evidence that his average grade for the whole of his preparatory course was at least 10% above the passing grade of the school from which he was graduated and that he has shown superior ability in athletics.

3. Nine sophomore, junior, and senior scholarships (three in each class) to be awarded to the best of those students who, during the previous year at Lehigh University, were free from failures in their studies, and whose scholastic record placed them among the highest 20% of their class. Preference will be given to those students who have shown qualities of leadership.

4. Nine sophomore, junior, and senior scholarships (three in each class) to be awarded to the best of those students who, during the previous year at Lehigh University, attained average grades at least 10% above the passing grade and distinction in athletics.

II. Forty scholarships (ten in each of the four classes) which provide deferred payment of tuition.

1. Five freshman scholarships to be awarded to the best of the candidates, each of whom must have shown superior scholastic ability in the high school or preparatory school from which he was graduated.

2. Five freshman scholarships to be awarded to the best of the candidates, each of whom must have shown at least average scholastic ability and athletic skill in the high or preparatory school from which he was graduated.

3. Fifteen sophomore, junior, and senior scholarships (five in each class) to be awarded to the best of the candidates who, during the previous year at Lehigh University, have shown superior ability as students.

4. Fifteen sophomore, junior, and senior scholarships (five in each class) to be awarded to the best of the candidates who, during the previous year at Lehigh University, have shown at least average ability as students and superior ability as athletes.

The free and deferred tuition scholarships are awarded for one collegiate year only. Holders of scholarships may apply for a renewal of their scholarships for subsequent collegiate years.

Applicants for free or deferred tuition scholarships, must, in every case, present satisfactory evidence of their need of financial assistance. Each student to whom a deferred tuition scholarship is awarded must each term execute a note jointly with one of his parents or guardians or some other financially responsible person, payable five years from date, with interest at 6%.

These scholarships cover tuition only. Students are not permitted to defer the payment of laboratory, health service, athletic, or other University fees.

Applications for the foregoing scholarships will regularly be considered by the Committee on Scholarships and Loans on July first of each year.

Application blanks for these scholarships may be obtained by addressing the Committee on Scholarships and Loans, Lehigh University, Bethlehem, Pa.

### THE WILBUR SCHOLARSHIP

The Wilbur Scholarship was founded in 1872 by the late E. P. Wilbur and provides the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

### THE HENRY S. HAINES MEMORIAL SCHOLARSHIP

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200 as a memorial to her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the Curriculum in Mechanical Engineering.

### THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pa., General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund called "The Fred. Mercur Memorial Fund." The income from this Fund, amounting to $600, is annually awarded to students of the University.

### THE JOSEPH MANN PRICKITT SCHOLARSHIP

Mr. and Mrs. Cooper H. Prickitt, of Burlington, N. J., established, in April, 1919, a scholarship, to be known as the Joseph Mann Prickitt Scholarship, in memory of their son, Joseph Mann Prickitt, of the Class of 1917, who died on March 10, 1916.

This scholarship is of sufficient amount to cover expenses for tuition, fees, and books. It is the expressed wish of the donors that the scholarship be awarded to graduates of the Burlington, N. J., High School on the nomination of the Principal of that school, subject to the approval of the President of the University, or in case of no nomination from that school that the award be made to deserving students from other places.

### THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $64,350, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of worthy students requiring financial aid.

### THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pa., a graduate of the Curriculum in Mining and Metallurgy of the Class of 1887, who died in October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $140,000, to found a fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their death the entire income will be available for loans.

### THE CALLENDER-CARNELL FELLOWSHIP

The Callender-Carnell Fellowship for the promotion of research in chemistry, established in 1919, is a gift of $1500 annually by an anonymous friend of the late George D. Callender, a chemist, who died in Chicago in 1914 while associated with the donor of the scholarship, and of the late William C. Carnell. Mr. Callender was a native of Linlithgow, Scotland, and was graduated from the chemistry department of Glasgow University. Mr. Carnell was a graduate of the Curriculum in Chemistry of Lehigh University, of the Class of 1894.

### THE WILBUR PRIZES

A fund was established by the late E. P. Wilbur for distribution in prizes as the Faculty shall determine. This fund yields an annual income of $100.

### THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the Department of English not later than the beginning of the second term in each year. Special stress will be laid upon clearness of thought and force of expression. Students must signify in writing their intention of competing not later than the first of April.

The subject for the prize essay in June, 1923, was "The Colonial Literature of Virginia."

### THE JOHN B. CARSON PRIZE

An annual prize of $50 was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pa., in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

### THE WILLIAM H. CHANDLER PRIZES IN CHEMISTRY

Four annual prizes in chemistry of $25 each were established in 1920 by the gift of Mrs. Mary E. Chandler, of Bethlehem, Pa., widow of Dr. William H. Chandler, who was Professor of

Chemistry in Lehigh University from 1871 until his death in 1906. In memory of Dr. Chandler the Faculty named the prizes "The William H. Chandler Prizes in Chemistry." Awards are made at the commencement exercises in June to the four members of the freshman, sophomore, junior, and senior classes deemed by the Faculty worthy to receive them.

### THE ELECTRICAL ENGINEERING PRIZE

An annual prize of $25, established by an anonymous graduate of the Electrical Engineering Curriculum, is awarded to the member of the graduating class presenting the best thesis in Electrical Engineering.

### ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1923, two prizes of $25 each were awarded to the first honor men of the Curricula in Civil and Mechanical Engineering. In subsequent years the prizes will be awarded to the first honor men of the technical curricula in turn.

### THE ALUMNI PRIZES FOR ORATORY

The Alumni Association of Lehigh University established in 1882 annual prizes for excellence in oratory, amounting to $50.

#### Regulations

1. The contest shall be held on the 22nd day of February, or on the day designated by the University to commemorate the birth of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third prize of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work.

The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

### THE WILLIAMS PRIZES IN ENGLISH

Professor Edward H. Williams, Jr., an alumnus of the University of the Class of 1875, established in February, 1900, prizes amounting annually to $335 for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

#### *Sophomore Composition Prizes*

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered in that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

#### *Senior Premiums*

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determinued upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, the length of which shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations

submitted to them and admit those which reach the above standard. In case none is up to the standard, and is admitted they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertations are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and the soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained, and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

## *Graduate Prize*

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery can be accomplished only through considerable research and study.

From this list any member of the class just graduating or of the Senior Class of the coming University year, any graduate of one year's standing whether in or out of residence, and any graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work at the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before a date which the Faculty shall select within one month before the next Commencement, which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those who fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of Lehigh University.

The winner of a prize shall not be allowed to compete again.

Professor Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

### THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation of $13,000 by the late Robert H. Sayre. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

## THE AMERICAN BUREAU OF SHIPPING ANNUAL EDUCATIONAL PRIZES

The Board of Managers of the Bureau, at their annual meeting held in January, 1924, voted to establish a system of cash prizes for scholarship at the various American institutions where the subjects of Naval Architecture and Marine Engineering are taught. The following rules have been adopted to govern the award of these prizes:

1. The prize shall consist of $100.00 in gold.

2. A prize shall be given annually to the student qualifying at each of the following institutions:

a. Cornell University.
b. Lehigh University.
c. Massachusetts Institute of Technology.
d. University of California.
e. University of Michigan.
f. Webb Institute of Naval Architecture.

Other institutions may be designated, when qualified under the terms of the award.

3. No award will be made to any student who is not an American citizen.

4. No award will be made to any student whose conduct and general standing is unsatisfactory.

5. As the early part of college courses is largely devoted to general education, the basis of the award shall be the highest average for the last two years of the course, in the regular prescribed subjects. Electives are not to be included in these averages.

6. Students who may come from other institutions and take the last two years of the courses in naval architecture and marine engineering may be considered as eligible for the award.

7. For the best interests of all concerned, holders of similar prizes or scholarships should not be considered as eligible.

8. The Faculty of the institution, or a committee of the main Faculty having jurisdiction over the courses involved, shall be the determinng agency in selecting the student to whom the award is to be made, governed by the general rules herein set forth. Any minor questions in connection with the award shall be decided by the committee of each institution having charge.

9. It is requested that the student who is to receive the award shall be selected at least two weeks before the graduating day, and notification of the selection made is to be forwarded to the President, American Bureau of Shipping, 50 Broad Street, New York City, immediately after the selection is made.

10. The awarding of these cash prizes shall become effective for classes graduating in 1925, the award in each case to cover scholarship demonstrated in the two college years preceding.

## GRADUATING THESES

Theses, when required, are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the student's record, for future reference, but copies may be retained by students, and may be published, permission being first obtained from the Faculty.

## UNIVERSITY LECTURES

From time to time during the University year, distinguished men in science, letters, art, and business give lectures before the student body.

Sophomores and juniors are required to attend these college lectures, and are given a total of one hour of credit toward graduation for attendance on three-fifths of the lectures given during the two years; *i. e.,* one-fourth credit hour per term. Students who fail to meet this requirement will be under the necessity of electing a substitute of the value of one credit hour. For seniors, attendance on the lectures is voluntary.

### FRESHMAN ORIENTATION LECTURES

For freshmen a special series of talks, known as "orientation lectures," is provided. These are designed to assist the new men in adapting themselves to the new University environment and to suggest how they may make the most profitable use of their opportunities. Freshmen are required to attend both these orientation talks and the regular college lectures. For attendance at three-fifths of the total number of lectures in each term, one-half term hour of credit toward graduation is given; freshmen who fail to attend three-fifths of the required lectures must repeat the course the following year.

### PLACEMENT SERVICE

The heads of the various technical curricula of the University coöperate with graduates in securing suitable professional openings.

Similarly, students who desire to teach are assisted in finding positions by the Faculty Committee on Teacher Placement. Such students are put in touch, also, with the Placement Service of the Teacher Bureau of the Department of Public Instruction of Pennsylvania at Harrisburg.

### STUDENTS' HEALTH SERVICE

The Students' Health Service, organized in 1923, has general charge of all health and sanitary measures in the University. The work of the department is organized under four heads:

Sanitation
Physical Examinations
Dispensary Service
Education

*Sanitation.* The Director of the Health Service is in direct charge of the sanitation of University buildings and grounds, and exercises such supervision as is possible over other accom-

modations for students. Special attention is given to the dormitories and to the University Commons, which are inspected frequently during the school year. All who handle food are examined in order that no disease-carriers may be employed.

*Physical Examinations.* Each student is required to undergo a complete physical examination each year. This examination, which is made jointly by the Health Service and the Department of Physical Education, serves the needs of both these departments and also complies with the requirements of the Reserve Officers' Training Corps. All physical defects and departures from normal are noted, and the students are divided into groups as follows: (a) those who present no abnormalities and who can proceed with the regular mental and physical work of the University; (b) those who are abnormal or sub-normal, but who should be brought up to normal by the regular courses in Physical Education; (c) those who present physical conditions requiring special or corrective gymnastic work; (d) those who require other corrective measures.

Those students who fall into classes b, c, and d are observed at regular intervals, and every effort is made to bring them up to the highest degree of physical development and health. Individual records are kept of the progress of each case.

*Dispensary Service.* The Health Service maintains a dispensary in Saucon Hall where students may receive free treatment for minor illnesses and injuries. The Dispensary hours are from 8.30 to 12.00 a. m. on all week days, from 1.30 to 5.00 p. m. on week days except Saturday, and from 9.30 to 10.30 a. m. on Sunday. The Director of the Health Service is in his office at the Dispensary during stated hours when students can consult him. While the Health Service does not furnish medical attendance to students who are sick in their rooms, the Director keeps in touch with such cases by telephone and otherwise in so far as is possible in order to see that the students are receiving proper attention and that the time lost from University work is minimized. It is requested that all such cases, together with the names of the attending physicians, be reported to the Director in order that complete records of the health of the students may be kept.

*Education.* A series of lectures on Personal and Social Hygiene is given to freshmen by the Director of the Health Service in conjunction with the Departments of Biology and Physical Education. In these lectures emphasis is laid on those points of Personal Hygiene most applicable to the student recently deprived of the atmosphere and influences of home. In Social Hygiene an effort is made to disseminate correct information concerning the history and present status of social diseases and the effectiveness of approved methods for the relief of existing conditions. This phase of the Health Service constitutes a specific part of the general program of instruction recommended by the State Board of Health and by other recognized organizations for the promotion of social hygiene.

### PUBLIC WORSHIP

Chapel exercises are held in Packer Memorial Church at 12 m. on every week day except Saturday. Attendance of freshmen and sophomores is required, of juniors and seniors voluntary.

### THE UNIVERSITY Y. M. C. A.

The Christian Association is a voluntary organization of students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student body. The office of the General Secretary is in Drown Memorial Hall.

### THE LEHIGH UNIVERSITY BAND

The University has a band, which is required to play at college activities and participate in military ceremonies when called upon by the Department of Military Science and Tactics. When participating in such ceremonies all members are required to wear military uniform, whether or not they are members of the Reserve Officers' Training Corps. These occasions occur once a week during the fall and spring and are of about twenty minutes' duration. Military uniforms, musical instruments, and music are furnished by the United States Government.

Students who elect band work and qualify for membership may substitute this work for their gymnasium classes and receive the same credit which they would normally receive from the Department of Physical Education. Those who are members of the Reserve Officers' Training Corps will also receive credit for one (1) hour of practical military drill a week.

In addition to the above credits, one (1) year of satisfactory service in the Band will entitle a student to a watch fob; two (2) years of service, a sweater; three (3) years, $20.00 in cash; and four (4) years, an additional $20.00 in cash.

These awards will be made only to those members of the Band who maintain at least sixty per cent. attendance each term at rehearsals, military ceremonies, and college activities.

### HONORARY SCHOLARSHIP SOCIETIES

PHI BETA KAPPA. Students in the College of Arts and Science and the College of Business Administration who up to the middle of the senior year maintain high scholarship may be elected to membership; also a limited number of technical students whose work in philosophical, scientific, and language studies is of high grade.

TAU BETA PI. Students in the College of Engineering who up to the middle of the junior year maintain high scholarship may be elected to membership.

### SOCIETIES OF THE COLLEGE OF ENGINEERING

An adjunct of value in promoting professional spirit in the College of Engineering is furnished by the departmental societies —voluntary organizations of students who meet monthly to present papers, to discuss engineering topics, and from time to time to hear addresses by invited engineers and scientists of note.

The first of these organizations historically was the Chemical Society, organized in 1871. The original Engineering Society, open to all technical students of the University, was started in 1872. From 1885 to 1889 it issued quarterly numbers of *The Journal of the Engineering Society of Lehigh University,* containing contributions by members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in the *Lehigh Quarterly* of those years.

Independent societies were formed in 1900 by students in the Departments of Civil Engineering and Mechanical Engineering. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. The Mining and Geological Society began in 1904, the Metallurgical Society in 1917, and the Railroad Society and the Naval Engineering Society in 1920.

### THE ARTS AND SCIENCE CLUB

The Arts and Science Club is the student society of the College of Arts and Science. It was founded in 1905, with the aim of promoting literary and cultural interests in the University. Students in all courses are eligible for membership. The programs of meetings include papers by members, discussions led by teachers in the College, and occasional talks by scholars from other institutions.

### FOUNDER'S DAY

On the first or second Saturday of October of each year, commemorative exercises are held in honor of the founder of the University. On Saturday, October 6, 1923, the forty-fourth Founder's Day was celebrated. In connection with these exercises Charles Maxwell McConn, A.M., was installed as Dean of the University.

### UNIVERSITY SUNDAY

The University sermon is preached on the Sunday before University Day. The Rt. Rev. Philip Cook, D.D., Bishop of Delaware, was the preacher on Sunday, June 11, 1922, in the Packer Memorial Church.

### UNIVERSITY DAY

University Day is the close of the collegiate year. On this day graduation exercises are held at which an address is given by a representative of the Alumni Association, prizes and honors are awarded, and degrees are conferred.

The program of the exercises on June 12, 1923, was as follows:

MUSIC
PRAYER
ALUMNI ADDRESS
WILLIAM SPENCER MURRAY, E.E., '95
*Engineering and Finance and Their Joint Relation to Accomplishment*
AWARD OF PRIZES AND HONORS
CONFERRING OF DEGREES
AWARD OF COMMISSIONS
BENEDICTION
"ALMA MATER"

## THE ALUMNI ASSOCIATION

The Alumni Association, which has been in existence since 1876, was incorporated in 1917 under the name The Alumni Association of the Lehigh University, Inc. The Alumni Secretary, who devotes all of his time to Association affairs, is Walter R. Okeson, '96. His offices are in the Drown Memorial Hall. Mr. Okeson edits the *Lehigh Alumni Bulletin,* a news publication issued monthly from October to June, inclusive, and the *Alumni and Student List.* The Association is largely concerned with raising money to meet the needs of the University.

The officers of the Alumni Association for 1923-24 are:

President, Clarence W. Hudson, '89, of New York, N. Y.
Vice-President, Harry A. White, '95, of Philadelphia, Pa.
Vice-President, Timothy Burns, '01, of Buffalo, N. Y.
Treasurer, J. Arthur Frick, '03, of Allentown, Pa.
Executive Secretary, Walter R. Okeson, '96, of Bethlehem, Pa.
Archivist, Preston A. Lambert, '83, of Bethlehem, Pa.
Assistant Secretary and Treasurer, Andrew E. Buchanan, '18, of Bethlehem, Pa.

Honorary Alumni Trustees: Homer D. Williams, '87, of Pittsburgh, Pa.; William C. Dickerman, '96, of New York, N. Y.; Taylor Allderdice, '83, of Pittsburgh, Pa.; Aubrey Weymouth, '94, of New York, N. Y.; Alan C. Dodson, '00, of Bethlehem, Pa.; and Henry D. Wilson, '01, of Pittsburgh, Pa.

The following are the local alumni clubs: New York Lehigh Club, Philadelphia Lehigh Club, Pittsburgh Lehigh Club, Chicago Lehigh Club, Washington Lehigh Club, Detroit Lehigh Club, Northeastern Pennsylvania Lehigh Club (Scranton and Wilkes-Barre, Pa.), Maryland Lehigh Club (Baltimore, Md.), Lehigh Club of New England (Boston, Mass.), Intermountain Lehigh Club (Salt Lake City, Utah), Lehigh Club of Central Pennsylvania, (Harrisburg, Pa.), Lehigh Club of Northern New York (Schenectady, N. Y.), Lehigh Club of Northern Ohio (Cleveland, O.), Lehigh Club of Southern New England (Hartford, Conn.), Lehigh Club of Western New York (Buffalo, N. Y.), Southern Anthracite Lehigh Club (Pottsville, Pa.), Lehigh Club of Arkansas (Little Rock, Ark.), Lehigh Home Club (Bethlehem, Pa.), Lehigh Club of China (Wuchang, China), Lehigh Club of Cuba (Havana, Cuba).

## PRIZES AND HONORS, 1923

### Announced on University Day, June 12, 1923

**Wilbur Prizes—Freshman Year**

*Mathematics,* First, $15—John Richard Pattison Perry, E.E., Centerville, Md.

Second, $10—Walter Mitchell Cree, Bus., Pittsburgh, Pa.

*English,* $15—Thomas Francis Reynolds, E.E., Bethlehem, Pa.

*German,* $15—Paul Kreidler Cressman, B.A., Bethlehem, Pa.

*French,* $15—Benjamin Weinstein, B.A., Philadelphia, Pa.; George Davis Long, C.E., Bolivar, Pa.; Kenneth Anthony Sheppard, C.E., Bridgeton, N. J., jointly.

**Price Prize in Freshman Composition, $25**—No award.

**Wilbur Scholarship—Sophomore Year, $200**

Allison Lerch Bayles, M.E., Charleston, S. C.

**Wilbur Prizes—Sophomore Year**

*Mathematics,* $10—Lee Harold Fister, E.E., Reading, Pa.

*English,* $10—Franklin Stewart Lerch, B.A., Freemansburg, Pa.

*Physics,* $10—Ralph Arthur Lambert, E.M., Bethlehem, Pa.

**Alumni Prizes—Junior Year,** two of $25 each

*Civil Engineering*—Robert William Ennis, C.E., Mt. Penn, Pa.

*Mechanical Engineering*—Louis Albert Laux, M.E., Baltimore, Md.

**John B. Carson Prize,** $50, best C.E. Thesis

Charles Fletcher Forstall, Rosemont, Pa.
Louis John Jacobson, Washington, D. C. } Jointly

**William H. Chandler Chemistry Prizes,** $25 each

*Freshman Year*—Joseph Gray Jackson, Ch.E., Bala, Pa.

*Sophomore Year*—James Bliss Austin, Ch.E., Chicago, Ill.

*Junior Year*—John C. Kitchen, Jr., Ch.E., Columbia, N. J.

*Senior Year*—Charles Heck Miller, Ch.E., Philadelphia, Pa.

**Electrical Engineering Prize,** $25, best E.E. Thesis

Clement Solomon Schifreen, E.E., Catasauqua, Pa.

**Tau Beta Pi Prize,** highest technical Freshman

Joseph Gray Jackson, Ch.E., Bala, Pa.

**Freshman Honors**

*Mathematics,* First—John Richard Pattison Perry, E.E., Centreville, Md.

Second—Walter Mitchell Cree, Pittsburgh, Pa.

*English,* First—Thomas Francis Reynolds, M.E., Bethlehem, Pa.

Second—Joseph Peter Bachman, Jr., Bus., Allentown, Pa.

*German,* First—Paul Kreidler Cressman, B.A., Bethlehem, Pa.

Second—Hartland Law, Ch.E., Camden, N. J.
Joseph Gray Jackson, Ch.E., Bala, Pa. } Jointly

*French,* First—Benjamin Weinstein, B.A., Philadelphia, Pa.
George Davis Long, C.E., Bolivar, Pa.
Kenneth Anthony Sheppard, C.E., Bridgeton, N. J. } Jointly

Second—Julian Ellis Fouchaux, E.E., Paterson, N. J.

**Sophomore Honors**

*Mathematics,* First—Lee Harold Fister, E.E., Reading, Pa.
Second—Ralph Arthur Lambert, E.M., Bethlehem, Pa.

*English,* First—Franklin Stewart Lerch, B.A., Freemansburg, Pa.
Second—Henri Victor DePuis Dykes, B.A., Bethlehem, Pa.

*Physics,* First—Ralph Arthur Lambert, E.M., Bethlehem, Pa.
Second—James Bliss Austin, Ch.E., Chicago, Ill.

**Junior Honors**

*College of Arts and Science,* First—Charles Francis Miller, B.A., Buchanan, Mich.
Second—Frederick Joseph Pearson, B.A., Wilkes-Barre, Pa.

*College of Business Administration,* First—Paul Shafter Burt, Bus., Washington, D. C.
Second—Warren Webster York, Bus., Scranton, Pa.

*College of Engineering*

*C. E. Curriculum,* First—Robert William Ennis, Mt. Penn, Pa.
Second—William Rorert Drake, Reading, Pa.

*M. E. Curriculum,* First—Louis Albert Laux, Baltimore, Md.
Second—Laylon Lavern Cupp, Baltimore, Md.

*Met. and E. M. Curricula,* First—Charles Bayard Mitchell, Woodbury, N. J.
Second—None

*E. E. Curriculum,* First—Ernest Wellington Baker, Harrisburg, Pa.
Second—James Stewart Grim, Jr., Kutztown, Pa.

*Chem. and Ch. E. Curricula,* First—John C. Kitchen, Jr., Columbia, N. J.
Second—George Hampton, Bridgeton, N. J.

*Mar. E. Curriculum,* First—No award
Second—No award

**Senior Honors**

*College of Arts and Science,* First—JOHN KENNETH BARRELL, Allentown, Pa.

Second—JOHN WERNER KREISEL, Pen Argyl, Pa.

*College of Business Administration,* First—WILLIAM JOSEPH HENRY STEINER, New York, N. Y.

Second—CHARLES ABBOTT VOSS, Brooklyn, N. Y.

*College of Engineering*

*C. E. Curriculum,* First—CHARLES RAYMOND WIRE, Washington, D. C.

Second—JOHN HAROLD VAN NESS, Paterson, N. J.

*M. E. Curriculum,* First—RICHARD HAUGHTON TILGHMAN, Overlea, Md.

Second—EDWIN ALDEN FERRIS, Ridgefield Park, N. J.

*Met. and E. M. Curricula,* First—ROBERT GAIR PFAHLER, Wilkes-Barre, Pa.

Second—No award

*E. E. Curriculum,* First—CLEMENT SOLOMON SCHIFREEN, Catasauqua, Pa.

Second—EDWIN FREDERICK RIEMAN, Tamaqua, Pa.

*Chem. and C. E. Curricula,* First—CHARLES HECK MILLER, Philadelphia, Pa.

Second—ALFRED GEORGE HEWITT, Washington, D. C.

*Mar. E. Curriculum,* First—JOSEPH COBLENTZ GROFF, New York, N. Y.

Second—No award

# DEGREES

## Conferred June 12, 1923

## DEGREES IN COURSE

### MASTER OF ARTS

| | |
|---|---|
| Henri Martin Barzun, B. es L. (*University of Paris*) | Bethlehem, Pa. |

### MASTER OF SCIENCE

| | |
|---|---|
| Malcolm Kee Buckley, B.S. (*Lehigh University*) | Bethlehem, Pa. |
| Wayne Hanley Carter, B.S. (*Lehigh University*) | Bethlehem, Pa. |
| William Alfred Everhart, A.B. (*Miami University*) | Granville, O. |
| Kenneth V. Glentzer, B.S. (*University of Indiana*) | Bethlehem, Pa. |
| Howard Dietrich Gruber, E.E. (*Lehigh University*) | Bethlehem, Pa. |
| Carl Harry McKenzie, B.S. (*Lehigh University*) | Dallas, Tex. |
| George Fred Nordenholt, M.E. (*Lehigh University*) | Bethlehem, Pa. |
| Henry Brunner Rau, B.S. (*Moravian College*) | Bethlehem, Pa. |
| Dzu-Kun Shen | Hankow, China |
| John Lammey Stewart, Jr., B.S. (*Pennsylvania State College*) | Bethlehem, Pa. |
| Sterling Booth Talmage, B.S. (*University of Utah*) | Salt Lake City, Utah |
| Ralph Vitilas Wetherhold, B.S. (*Muhlenberg College*) | Allentown, Pa. |

### BACHELOR OF ARTS

| | |
|---|---|
| Conrad Mortimer Bahnsen | Nazareth, Pa. |
| John Kenneth Barrall | Allentown, Pa. |
| Elmer Morton Bloch | Newport, R. I. |
| Willard Albert Solomon Boyer | Lehighton, Pa. |
| Calvin Claude Christman | Lehighton, Pa. |

| | |
|---|---|
| George Jacob Desh | Belfast, Pa. |
| Howard Franklin Fehr | Bethlehem, Pa. |
| David King Getz | Allentown, Pa. |
| Linus Kenneth Harkins | Homestead, Pa. |
| Samuel Lawrence Kaman | New York, N. Y. |
| John Werner Kreisel | Pen Argyl, Pa. |
| Tilghman Albert Lambert | Bethlehem, Pa. |
| Frederick William Lewis | Pottsville, Pa. |
| Wilbert David Muschlitz | Bethlehem, Pa. |
| Marcus Calvin Old | Allentown, Pa. |
| Frank Pill, Jr. | Califon, N. J. |
| Thomas Wesley Schwab, Jr. | Bath, Pa. |
| Leslie Wright Stanley | Williamsport, Pa. |
| Edwin Van Keuren | Bethlehem, Pa. |

## BACHELOR OF SCIENCE

| | |
|---|---|
| Thomas Henry Asbury, 2nd | Philadelphia, Pa. |
| Robert Power Balderson | Pittsburgh, Pa. |
| Raymond Joseph Bobbin | Shenandoah, Pa. |
| Clifton Newton Bradley | Brooklyn, N. Y. |
| William Albert Carlisle | Luthersburg, Pa. |
| Wilfred Clinton Compher | Poolesville, Md. |
| John Francis Conlin, Jr. | Philadelphia, Pa. |
| Julian Washington Gardy | Doylestown, Pa. |
| George Darr McConnell | Butler, Pa. |
| Francis Callistus O'Keefe | Rockville, Conn. |
| Joseph Patrick Redington | Wilkes-Barre, Pa. |
| John Stewart Stanier | Tarentum, Pa. |
| William Joseph Henry Steiner | New York, N. Y. |
| Charles Abbott Voss | Brooklyn, N. Y. |
| Edward Allen Wallace, Jr. | Grand Rapids, Mich. |
| James Wentz | New York, N. Y. |
| Barney Louis Wolensky | Palmerton, Pa. |

## CIVIL ENGINEER

| | |
|---|---|
| Stanford Edward Abel | Washington, D. C. |
| Charles Roland Bush, Jr. | Washington, D. C. |
| David Messer Clarke | Bee Ridge, Fla. |
| Joseph Albert Dehnick | Atlantic City, N. J. |
| Frank Hart DeMoyer | Camden, N. J. |
| Charles Fletcher Forstall | Rosemont, Pa. |

| | |
|---|---|
| Henry Werner Gentzlinger | New York, N. Y. |
| Louis John Jacobson | Washington, D. C. |
| Walter Merritt Kocher | Allentown, Pa. |
| Irwin Faust Kurtz | Pottstown, Pa. |
| Sylvester Makens Larkin | Norristown, Pa. |
| John Luther Lees | Hellertown, Pa. |
| Frank Henry Leister, Jr. | North Wales, Pa. |
| Francis James Lloyd, Jr., B.A. (*St. John's College*) | Pocomoke City, Md. |
| William Raymond Mattson | Rockledge, Pa. |
| Godofredo Moraes deMenezes | Aracaju, Brazil |
| Joseph Fretz Moyer | Quakertown, Pa. |
| John Hedrick Olcott | Grencarlyn, Va. |
| John Mason Read | Washington, D. C. |
| Byron Elmer Rhoades, Jr. | Big Stone Gap, Va. |
| Elmer Lincoln Richards, Jr. | Somerville, N. J. |
| Raymond Philip Ruger | Philadelphia, Pa. |
| Lewis Foulke Shoemaker, Jr. | Devon, Pa. |
| Arthur Louis Siemann | Brooklyn, N. Y. |
| Hubert Bell Smith | Philadelphia, Pa. |
| John Harold Van Ness | Paterson, N. J. |
| Percy Franklin Walker | Harrisburg, Pa. |
| Joseph Edward Walton | Bethlehem, Pa. |
| Paul Edwin Wilkins | Baltimore, Md. |
| Charles Raymond Wire | Washington, D. C. |

## MECHANICAL ENGINEER

| | |
|---|---|
| William Van Wert Amig | Baltimore, Md. |
| Horace Clifton Beitzel, Jr. | Moorestown, N. J. |
| Lennox Jerome Bray | Westerly, R. I. |
| James White Carey, Jr. | Wenonah, N. J. |
| Henry Lewis Chisholm, Jr. | Buffalo, N. Y. |
| Arthur Cabot Cusick | Roxbury, Mass. |
| Edward Chester Davis | Taylor, Pa. |
| Edwin Alden Ferris | Ridgefield Park, N. J. |
| Cyril Hughes Foot | Westfield, N. J. |
| Philip Halstead Hartung | Yonkers, N. Y. |
| Lloyd Benjamin Kehler | Shamokin, Pa. |
| William Robert Kilbourn | Williamsport, Pa. |
| Charles Gotthilf Knobel | Allentown, Pa. |

| | |
|---|---|
| Wilbur Kratz | Baltimore, Md. |
| Andrew Wilson Muirhead | Bridgeport, Conn. |
| Donald Mott Quick | Yonkers, N. Y. |
| John Wright Taylor, Jr. | Century, Fla. |
| Richard Haughton Tilghman | Overlea, Md. |
| Herbert Francis Underwood | Brooklyn, N. Y. |
| Donald Miller Wight | Washington, D. C. |

## METALLURGICAL ENGINEER

| | |
|---|---|
| Charles Owen Burgess | Niagara Falls, N. Y. |
| Arthur Morgan Creighton | Bayonne, N. J. |
| Harrie Lyon Day | Ogdensburg, N. Y. |
| James Stewart Huston | Coatesville, Pa. |
| Jack Kauffman Killmer | Reading, Pa. |
| William Miller Laughton | Washington, D. C. |
| Michael Charles Joseph McFadden | Bethlehem, Pa. |
| Irvin Sterner Reiter | Bethlehem, Pa. |
| Olin Curtis Sheetz | Philadelphia, Pa. |
| Adolph Gustave Wuethrich | Perth Amboy, N. J. |

## ENGINEER OF MINES

| | |
|---|---|
| Henry Conrad Bieg | Philadelphia, Pa. |
| John Palmer Camm | Atlantic City, N. J. |
| James Hazen Darsie | West Homestead, Pa. |
| Lyman LeRoy Dixon | Flushing, N. Y. |
| Richard Morris Graff | Worthington, Pa. |
| Erwin Casper Handwerk | Slatedale, Pa. |
| Adam Edward Hauck | Buffalo, N. Y. |
| Albert Willet Hicks, Jr. | Allentown, Pa. |
| Adam Hannan Hitchner | Woodbury, N. J. |
| Samuel Llewellyn Lebovitz | Baltimore, Md. |
| Robert Gair Pfahler | Wilkes-Barre, Pa. |
| Harradon Reets Randall | Shamokin, Pa. |
| John Bunyan Robinson | Chester, Pa. |
| Alvin August Claus Schwarzbach | Newark, N. J. |
| William Gardiner Thompson | Richmond Hill, N. Y. |
| George Wilmer Walters | Cazenovia, N. Y. |

## ELECTRICAL ENGINEER

| | |
|---|---|
| Swope Acker | Baltimore, Md. |
| Carl Wilson Appel | Allentown, Pa. |
| Frederick Edwin Barber | Allentown, Pa. |
| Robert Webb Barrell, Jr. | St. Louis, Mo. |
| Charles Fletcher Bishop | Williamsport, Pa. |
| John Henry Blankenbuehler | Elizabeth, Pa. |
| Carl Franklin Bodey | Reading, Pa. |
| Reginald Philip Brotzman | Easton, Pa. |
| Edward Haviland Coxe, Jr. | Pittsburgh, Pa. |
| Elliott Foster Daniels | Jersey City, N. J. |
| Charles Luther Derrick | Washington, D.C. |
| Samuel Farace | Baltimore, Md. |
| Edward Hardcastle | Easton, Md. |
| William Mason Hoke | Lebanon, Pa. |
| George Schneider Koch | Washington, D. C. |
| Allan Reuel Kramer | Coplay, Pa. |
| Charles Horner Kressler | Finesville, N. J. |
| Harry Benton Mecaslin, Jr. | Baltimore, Md. |
| Joseph Pilkay Minnich | Harrisburg, Pa. |
| George Christopher Picht, Jr. | Bethlehem, Pa. |
| Eugene Desire Regad | Irvington, N. J. |
| Edwin Frederick Rieman | Tamaqua, Pa. |
| Clement Solomon Schifreen | Catasauqua, Pa. |
| Edwin Henry Snyder | Washington, D. C. |
| Lewis Howard Van Billiard | Bethlehem, Pa. |
| David Thomas Werner | Lebanon, Pa. |
| Harry Elwood Yeide | Weatherly, Pa. |

## CHEMICAL ENGINEER

| | |
|---|---|
| Edward Belknap Beale | Washington, D. C. |
| Rodney Maurer Beck | Philadelphia, Pa. |
| Paul Frederick Benz | Haledon, N. J. |
| George Centennial Borden, Jr. | Asbury Park, N. J. |
| Frederick Wanner Glasmire | Bethlehem, Pa. |
| Ralph Alonzo Hales | Washington, D. C. |
| Alfred George Hewitt | Washington, D. C. |
| Charles Heck Miller | Philadelphia, Pa. |
| Samuel Craig Nevins | Tamaqua, Pa. |
| Theodore Otto Petersen | Philadelphia, Pa. |

| | |
|---|---|
| Oscar Frederick Roller, Jr. | Philadelphia, Pa. |
| Russell Rubba | Hammonton, N. J. |
| Edward Marsh Sansom | Cranford, N. J. |
| Everett Gordon Schaefer | New York, N. Y. |
| Charles Melson Schragger | Trenton, N. J. |
| Russell Tonking | Dover, N. J. |

### NAVAL ENGINEER

| | |
|---|---|
| Warren Brewer | Newton Center, Mass. |
| Charles Melvin Fancher | Elizabeth, N. J. |
| Joseph Coblentz Groff | New York, N. Y. |
| James Xavier Molloy | Bridgeport, Conn. |
| Stanton Elwell Nadig | Allentown, Pa. |

## HONORARY DEGREES

### DOCTOR OF ENGINEERING

| | |
|---|---|
| William Spencer Murray, E.E., '95 | New York, N. Y. |

### DOCTOR OF LAWS

| | |
|---|---|
| José Ramón Villalón, C.E., '90 | Havana, Cuba |

**Conferred on Founder's Day, October 6, 1923**

### MASTER OF ARTS

| | |
|---|---|
| Leonore Danbrook Shimer Browne, A.B. (*Smith College*) | Bethlehem, Pa. |
| Howard James Yeager, A.B. (*Franklin and Marshall College*) | Emaus, Pa. |

### BACHELOR OF ARTS

| | |
|---|---|
| Jamieson Douglas Kennedy | North Adams, Mass. |

### BACHELOR OF SCIENCE

| | |
|---|---|
| Stephen Joseph Bessemer | Bethlehem, Pa. |
| Thomas Vincent Ganey | Bethlehem, Pa. |
| John Hinkle Opdycke | Philadelphia, Pa. |
| Thomas William Stanton | Montclair, N. J. |

### CIVIL ENGINEER

| | |
|---|---|
| Friend Raymond Lodge | Philadelphia, Pa. |
| Charles Raymond Minnick | Robesonia, Pa. |

## MECHANICAL ENGINEER

| | |
|---|---|
| Richard Kutzleb, Jr. | Baltimore, Md. |

## METALLURGICAL ENGINEER

| | |
|---|---|
| John Edgar Erb | Middletown, Pa. |

## ENGINEER OF MINES

| | |
|---|---|
| Everett Judd Decker | Mountain Lakes, N. J. |
| Carlos Alphonso Freeman | Caracas, Venezuela |
| Joel Longnecker Light | Allentown, Pa. |
| Frederick Snyder Mitman | Bethlehem, Pa. |

## ELECTRICAL ENGINEER

| | |
|---|---|
| Frank Elliott Ferguson, Jr.. | Washington, D. C. |
| John Douglas McPherson, 3rd | Fair Oaks, Cal. |

# STUDENTS

B.A.—Bachelor of Arts
Bus.—Business Administration
C.E.—Civil Engineering
Ch.E.—Chemical Engineering
Chem.—Chemistry
E.E.—Electrical Engineering
E.M.—Mining Engineering
E.Ph.—Engineering Physics
Mar.E.—Marine Engineering
M.E.—Mechanical Engineering
Met.—Metallurgy

## GRADUATE STUDENTS

| | For Degree | Residence |
|---|---|---|
| Anderson, Harry Victor, B.Ch.E. (*University of Michigan*) | M.S. | Bethlehem |
| Anderson, (Mrs.) Rachel Evans, A.B. (*Wellesley College*) | M.S. | Easton |
| Billinger, Robert Dominick, Ch.E. (*Lehigh University*) | M.S. | Bethlehem |
| Carroll, Clara, B.A. (*Moravian College for Women*) | M.A. | Bethlehem |
| Christman, Franklin A., B.S. (*Muhlenberg College*) | M.A. | Northampton |
| Convers, Gilbert Castillejo, B.S., Ph.B. (*Colegio Superior,* Bawanquilla, Columbia) (*Universidad de Cochabamba,* Bolivia) | M.A. | Bethlehem |
| Diamond, Harry, B.S. (*Massachusetts Institute of Technology*) | M.S. | Bethlehem |
| Ewing, Boyd Ross, Jr., B.A. (*Lehigh University*) | M.A. | Bethlehem |
| Farber, Hobart Amory, B.A. (*Lehigh University*) | M.A. | Bethlehem |
| Fehr, Howard Franklin, B.A. (*Lehigh University*) | M.S. | Bethlehem |
| Fink, William LeRoy, A.B. (*Ursinus College*) | M.A. | Slatington |
| Fritsch, John Warren, B.A. (*Muhlenberg College*) | M.A. | Allentown |
| Fry, Howard Massey, E.E., M.S. (*Lehigh University*) | | Bethlehem |

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|---|---|---|
| Greider, Emma Cora, B.A. (*Hunter College*) | M.S. | Stroudsburg |
| Hassler, Roy Diehm, B.S. (*Moravian College*) | M.S. | Bethlehem |
| Hofford, Hilda Naomi, B.A. (*Moravian College for Women*) | M.A. | Allentown |
| Kern, Nelson Eugene, Ph.B. (*Muhlenberg College*) | M.A. | Allentown |
| Kingsley, Ernest Roy, B.S. (*University of Maine*) | M.S. | Bethlehem |
| Kistler, Paul Norman, B.S. (*Pennsylvania State College*) | M.S. | Bethlehem |
| Knauss, Calvin Ambrose, B.S. (*Muhlenberg College*) | M.S. | Bethlehem |
| Kreidler, William Alfred, B.S. (*Lehigh University*) | M.S. | Bethlehem |
| Kunkel, George A. (*Muhlenberg College*) | M.A. | Hellertown |
| Leach, Lester Lorraine, B.S. (*University of Missouri*) | M.S. | Bethlehem |
| Lyle, George Averett, B.S. (*Hampden-Sidney College*) | M.A. | Bethlehem |
| Martin, Robert Earl, A.B., M.S. (*Indiana University*) (*Lehigh University*) | | Bethlehem |
| Miller, Archie Roscoe, B.S. (*University of Illinois*) | M.S. | Bethlehem |
| Old, Marcus Calvin, B.A. (*Lehigh University*) | M.A. | Bethlehem |
| Perkins, Wallace Wyman, A.B. (*Harvard University*) | M.A. | Bethlehem |
| Quast, Walter Flamm, M.E. (*Lehigh University*) | M.S. | Bethlehem |
| Riley, John David, Jr., B.S. (*University of Pennsylvania*) | M.S. | Bethlehem |
| Rousing, Niels, Ch.E. (*Royal Technical College, Copenhagen*) | M.S. | Randers, Denmark |
| Schwab, Thomas Wesley, Jr., B.A. (*Lehigh University*) | M.A. | Bath |

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|---|---|---|
| Shirey, William Brown, A.B., A.M. (*West Virginia University*) (*University of Wisconsin*) | | Bethlehem |
| Smiley, Earl Kenneth, A.B. (*Bowdoin College*) | M.A. | Bethlehem |
| Smith, Norman E., A.B. (*Pennsylvania State College*) | M.A. | Slatington |
| Snyder, James W., A.B., M.A. (*Bucknell University*) | M.A. | Slatington |
| Solt, Marvin Reinhard, B.S. (*Lehigh University*) | M.A. | Bethlehem |
| Taylor, Robert Norman, Ph.B., B.S. (*Muhlenberg College*) | M.A. | Hellertown |
| Thomas, George Edward, Ph.B. (*Muhlenberg College*) | M.A. | Allentown |
| Thompson, Richard N., A.B. (*Cornell University*) | M.A. | Bethlehem |
| Van Keuren, Edwin, B.A. (*Lehigh University*) | M.A. | Bethlehem |
| Wetherhold, Mark Andrew, B.S. (*Muhlenberg College*) | M.S. | Allentown |
| Wilson, Genevieve, A.B. (*University of Pennsylvania*) | M.A. | Bethlehem |
| Zinszer, Harvey Alfred, B.A. (*Lehigh University*) | M.S. | Bethlehem |

## SENIOR CLASS

### Class of 1924

| *Name* | *Curriculum* | *Residence* |
|---|---|---|
| Abel, George Justin | M.E., | Elizabeth, N. J. |
| Adams, Edgar Thomas, Jr. | E.M., | Crafton. |
| Alford, Charles Mahin | E.E., | East Orange, N. J. |
| Allan, Robert Houston | Bus., | Jermyn. |
| Alwine, Charles Emory | E.E., | New Oxford. |
| Ayers, Wm. DeWitt | C.E., | Branchville, N. J. |
| Baker, Ernest Wellington | E.E., | Harrisburg. |
| Bennett, Edmund VanGilder | Met., | Lansdale. |
| Berg, Frederick Christian | Mar.E., | Philadelphia. |

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|---|---|---|
| Bishop, Morris Earl | B.A., | Bethlehem. |
| Boggs, George Warren | Bus., | Melrose Park. |
| Bond, Luther Gerber | M.E., | York. |
| Bonny, Henry Ernest | B.A., | Pen Argyl. |
| Boyd, James Andrew | Bus., | Montvale, N. J. |
| Boyden, Wilson Gorden | E.E., | Greenwich, Conn. |
| Boyle, Joseph, Jr. | Bus., | Paterson, N. J. |
| Bridegam, Warren James | E.E., | Reading. |
| Bugbee, Jesse Albert | C.E., | Trenton, N. J. |
| Bumbaugh, Frank Taylor | Met., | Monessen. |
| Burnes, William Ryan | C.E., | Port Chester, N. Y. |
| Burt, Paul Shafter | Bus., | Washington, D. C. |
| Callahan, Geo. White Gregory, Jr. | C.E., | Newport, R. I. |
| Campbell, Paul Frederick | C.E., | Swedesboro, N. J. |
| Canavan, William Paul | B.A., | Chester. |
| Carol, Jose Maria | C.E., | Cardinas, Cuba. |
| Carter, Norman Campbell | Chem., | Phoenixville. |
| Chang, Kuang-Ming | Met., | Washington, D. C. |
| Conley, Thomas George, Jr. | E.M., | Pittsburgh. |
| Cornelius, Charles Taylor | M.E., | Pittsburgh. |
| Corneilius, George Emil Wagner | Bus., | McKeesport. |
| Craig, Thomas Benneville | M.E., | Slatington. |
| Cupp, Laylon Lavern | M.E., | Williamsport. |
| Danko, John Vincent | E.M., | Port Chester, N. Y. |
| Davis, William Schaff, Jr. | E.M., | Lebanon. |
| Degnan, James Michael, Jr. | E.E., | Bethlehem. |
| DiBiase, James | Bus., | Newark, N. J. |
| Dick, Donald Benner | Bus., | Hazleton. |
| Diener, Walter Miller | M.E., | Hamburg. |
| Dietrich, Robert Charles | B.A., | High Bridge, N. J. |
| Dietz, Joseph Budding | Ch.E., | Lancaster. |
| DiGuilian, Attilio Peter | C.E., | Washington, D. C. |
| Donaldson, Kenneth | C.E., | Washington, D. C. |
| Drake, William Robert | C.E., | Reading. |
| Edson, Warren Newton | C.E., | Scranton. |
| Emanuel, Robert Samuel | M.E., | Nesquehoning. |
| Ennis, Robert William | C.E., | Mt. Penn. |
| Fegley, Claude Andrew | B.A., | Bethlehem. |
| Ferry, John Francis | E.E., | Allentown. |

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| Fleck, Paul Butler | E.M., | Pittsburgh. |
| Focht, Louis Doster | E.M., | Trenton, N. J. |
| Forney, Charles David | E.E., | Hanover. |
| Foster, Arthur | E.E., | Big Stone Gap, Va. |
| Fritzsche, Otto Herbert Adolph | C.E., | Irvington, N. J. |
| Galloway, Beverly Stewart | B.A., | Washington, D. C. |
| Gee, Elisha, Jr. | B.A., | Denver, Colo. |
| Gerhart, Paul LeRoy | E.E., | Reading. |
| Gihon, Harry David | M.E., | Trenton, N. J. |
| Glen, Maxwell | Bus., | Newbury, Mass. |
| Gorham, Edward Werrey | Ch.E., | Brooklyn, N. Y. |
| Grace, Carroll Brewster | M.E., | Germantown. |
| Graham, George Tinsley | Bus., | Bethlehem. |
| Grambs, George Lorenzo | B.A., | Scranton |
| Green, Kenneth William | E.E., | Weissport. |
| Greer, Harry Ross | B.A., | Atlanta, Ga. |
| Grim, James Stewart, Jr. | E.E., | Kutztown. |
| Hagenbuch, Edward Allen | E.E., | Allentown. |
| Hampton, George | Ch.E., | Bridgeton, N. J. |
| Hartman, Edward Paul | Met., | Bethlehem. |
| Hauser, Stanley LeRoy | Met., | Kutztown. |
| Hawkins, Richard Arthur | E.M., | Forty Fort. |
| Heckert, Robert Augustus | B.A., | Brackenridge. |
| Heimbrook, Charles Albert | Bus., | Bethlehem. |
| Hendrickson, Francis Lynn | E.M., | Woodbury, N. J. |
| Heske, Walter Gottlieb | Met., | Bethlehem. |
| Hewson, Edward Haskell | Mar.E., | Havana, Cuba. |
| Hiller, Charles Francis | B.A., | Buchanan, Mich. |
| Hoagland, Dan Parmlee, Jr. | B.A., | Bayonne, N. J. |
| Hoffman, William Jacob | B.A., | Raubsville. |
| Homeyer, William Henry | B.A., | Jersey City, N. J. |
| Hopkins, George Whitefield | M.E., | Cleveland, O. |
| Hottinger, Alwin Julius | Met., | Kenvil, N. J. |
| Howell, Richard Paulmier | E.M., | Bethlehem. |
| Hunter, Francis Alexander | M.E., | Hoboken, N. J. |
| Ingols, Heber Ashe | Ch.E., | Newark, N. J. |
| Jamieson, John Jay Ivory | Met., | Frackville. |
| Jamison, Earl Helms | M.E., | Hazleton. |
| Jenkins, George French | E.M., | Binghampton, N. Y. |
| Johnson, Alfred William | E.E., | West Hartford, Conn. |

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| Jones, Gordon Tyron | B.A., | Edwardsville. |
| Kasper, Ralph Joseph | Mar.E., | Ridgefield, Conn. |
| Kemmerer, Walter William | B.A., | Wind Gap. |
| Kichline, William Levi | B.A., | Bethlehem. |
| Kiefer, Herman Eugene, Jr. | C.E., | Quincy, Ill. |
| Kitchen, John C. | Ch.E., | Columbia, N. J. |
| Klein, Walter Conrad | B.A., | Pottsville. |
| Knouse, Walter Earl | E.E., | Washington, D. C. |
| Kravitz, Raphael | E.M., | Atlantic City, N. J. |
| Langfitt, James Porter | B.A., | Parkersburg, W. Va. |
| Laux, George August | M.E., | Baltimore, Md. |
| Laux, Louis Albert | M.E., | Baltimore, Md. |
| Levy, Bertram Rich | E.E., | Brooklyn, N. Y. |
| Light, Berlin Carl | Ch.E., | Reading. |
| Litke, Harry Theodore | C.E., | Millville, N. J. |
| Long, Willoughby James | Met., | Bethlehem. |
| Lord, Edward Thomas Warren | Ch.E., | Philadelphia. |
| Luce, Donald Cameron | E.E., | Scranton. |
| MacKenzie, Adrian Morrell | Bus., | Englewood, N. J. |
| Mackenzie, Sidney Thompson | Mar.E., | Philadelphia. |
| McBride, Joseph Aloysius | M.E., | Philadelphia. |
| McIntire, Robert Lester | Bus., | Butler. |
| Maguire, Joseph Anthony | B.A., | Vineland, N. J. |
| Magruder, Filbert Tyler | M.E., | Winchester, Va. |
| Major, William Samuel | Ch.E., | Roebling, N. J. |
| Mandell, Leon Nathaniel | Ch.E., | Philadelphia. |
| Martin, Frederic Thurman | Ch.E., | Harrisburg. |
| Master, Warren | E.E., | Reading. |
| Maxwell, Thomas | E.E., | Baltimore, Md. |
| Metzner, Russell, Henry | M.E., | Wheeling, W. Va. |
| Meyer, William Charles | E.E., | Bethlehem. |
| Miller, Philip Robert | B.A., | Bethlehem. |
| Milligan, John Ralph | Bus., | East Liverpool, O. |
| Mitchell, Charles Bayard | E.M., | Woodbury, N. J. |
| Moore, Myron Turner | Bus., | Youngstown, O. |
| Northup, Maynard Sampson | Met., | Allentown. |
| Palmer, Henry Parsons | C.E., | Langhorne. |
| Parsons, Donald Adelbert | M.E., | New Rochelle, N. Y. |
| Patterson, John Alexander | Ch.E., | Bywood. |
| Pearson, Frederick Joseph | B.A., | Wilkes-Barre. |

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| Penwell, Max Kenneth | M.E., | Pana, Ill. |
| Piersol, John Marshall | M.E., | Philadelphia. |
| Quinlan, Eldridge Edward | Bus., | Yonkers, N. Y. |
| Rakestraw, Theodore Horace | M.E., | Mechanicsburg. |
| Ratajczak, Frank Xavior | E.E., | Reading. |
| Redline, Paul Wilson | E.M., | Bethlehem. |
| Reese, Benjamin Harvey | Bus., | Kingston. |
| Reyer, William Aaron | Chem., | Northampton. |
| Reynolds, Joseph Lee | M.E., | Kingston. |
| Rhoads, Ronald Sage | E.M., | Nutley, N. J. |
| Rice, Charles Lewis | C.E., | Hazleton. |
| Rice, Janvier Mayhew | E.E., | Bridgeton, N. J. |
| Rice, Robert MacLean | E.E., | Reading. |
| Richards, Louis Moore | M.E., | Somerville, N. J. |
| Richardson, Edward Hardy | C.E., | Malvern. |
| Ritter, Ralph Sheely | E.E., | Quakertown. |
| Roberts, Arthur Parsons | Bus., | Englewood, N. J. |
| Robinson, Edmund Lewis | E.E., | Bethlehem. |
| Robinson, H. G. | M.E., | Trenton, N. J. |
| Robinson, John Mealy | M.E., | Pittsburgh. |
| Rogers, Henry Fordon | Chem., | Newark, N. J. |
| Rogers, John Frederick | Bus., | Buffalo, N. Y. |
| Rohrer, Henry Augustus | M.E., | Lancaster. |
| Ross, Jack Elton | C.E., | Newark, N. J. |
| Roth, Milton Samuel | B.A., | Butler. |
| Rouch, Ernest Allen | M.E., | York. |
| Sanford, James Leo | B.A., | Brooklyn, N. Y. |
| Sattenstein, Sidney Lincoln | E.E., | Reading. |
| Saunders, Oliver Hubbard | M.E., | Brooklyn, N. Y. |
| Sayre, Austin Bartholomew | B.A., | Ridgewood, N. J. |
| Scheetz, Edwin Fread | E.M., | Wyncote. |
| Schleicher, Wallace Mengel | Mar.E., | Maplewood, N. J. |
| Schrauff, Henry John | E.M., | Jersey City, N. J. |
| Schultz, Albert Novinger | E.E., | Williamsport. |
| Schwartz, Paul Englebert | Bus., | Harrisburg. |
| Shigo, John Joseph, Jr. | B.A., | Hazleton. |
| Shoemaker, Howard Edward W. | C.E., | Freeland. |
| Skeels, Walter Simeon | E.M., | Rochester, N. Y. |
| Smith, Thomas Cameron | M.E., | Allentown. |

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|---|---|---|
| Snyder, Frederick Deppen | Ch.E., | Harrisburg. |
| Springsteen, Arthur Wellington | B.A., | Detroit, Mich. |
| Stauffer, Edwin Lewis | Ch.E., | Northampton. |
| Stern, Paul Hertzler | B.A., | Franklin, N. J. |
| Stille, Francis Carroll | E.M., | Woodbury, N. J. |
| Strawn, Eli Howard | C.E., | Quakertown. |
| Swartley, John Cassel | B.A., | Doylestown. |
| Swartz, Ralph Christian | M.E., | Allentown. |
| Thayer, James Stansbury | M.E., | Baltimore, Md. |
| Thomas, William Howard Holland | B.A., | New Haven, Conn. |
| Thompson, Walter Scott | E.E., | Sunbury. |
| Todd, James Arnold | Chem., | Doylestown. |
| Troland, Hugh Moore | C.E., | Philadelphia. |
| Troutman, Roy Ezra | Chem.; | Bethlehem. |
| Trumbore, Frederick William | B.A., | Bethlehem. |
| Underwood, Ralph Edward | B.A., | Great Neck, N. Y. |
| Urban, Stanley Joseph | E.M., | Allentown. |
| VanDyke, John Harrison | M.E., | Pittsburgh. |
| Villaume, Frederick Henry | E.M., | New York, N. Y. |
| Walters, Frank Clayton | Mar.E., | Bethlehem. |
| Warriner, Ruel Dexter | E.M., | Philadelphia. |
| Wasser, Floyd Henry | Met., | Bethlehem. |
| Webb, Robert Stanford | M.E., | Asheville, N. C. |
| Wehrenberg, William, Jr. | E.E., | Baltimore, Md. |
| Wentz, Graham | Chem., | Scranton. |
| Werft, Ellis Lincoln | E.M., | Altoona. |
| Wiegner, Andrew Newton | C.E., | Bethlehem. |
| Wingate, Bruce Kuglow | C.E., | Reading. |
| Wood, Arthur | B.A., | Providence, R. I. |
| Woodrow, Maurice O. | C.E., | Wilkes-Barre. |
| Woolridge, William Potter | E.M., | Pittsburgh. |
| York, Warren Webster | Bus., | Scranton. |
| Yuan, Tung | E.M., | Peking, China. |
| Zannaras, John Philippe | Mar.E., | Bethlehem. |
| Ziegenfuss, Charles Edwin | Bus., | Bethlehem. |

## JUNIOR CLASS

### Class of 1925

| *Name* | *Curriculum* | *Residence* |
|---|---|---|
| Akialis, Joseph Michael | Ch.E., | Newark, N. J. |
| Allen, Charles Wesley | E.M., | Reading. |

| | | |
|---|---|---|
| Allen, Walter Rue | E.E., | East Orange, N. J. |
| Astarita, Francis Sanford | Bus., | New York, N. Y. |
| Austin, James Bliss | Ch.E., | Washington, D. C. |
| Ayres, Clarence Cornelius | E.E., | Chester. |
| Barton, Frederick Charles, Jr. | Bus., | Tenafly, N. J. |
| Batz, Kenneth William Yates | M.E., | Stapleton, N. Y. |
| Bayles, Allison Lerch | M.E., | Charleston, S. C. |
| Beck, Frederick Charles | E.E., | Philadelphia. |
| Beggs, Charles Wendell | Ch.E., | Wilkinsburg. |
| Behr, William John, Jr. | Mar.E., | Montclair, N. J. |
| Bergen, Lewis Spaden | E.M., | Matawan, N. J. |
| Berger, Francis Joseph | E.E., | Wilkes-Barre. |
| Best, Ralph Walter | E.E., | Allentown. |
| Bevan, James Elmer | E.E., | Frackville. |
| Binkley, Edward Lehman | E.E., | Hagerstown, Md. |
| Blake, Alfred Greene | C.E., | Pittsburgh. |
| Bokum, William Harold | E.E., | Philadelphia. |
| Bond, Louis Boutell | M.E., | Philadelphia. |
| Borda, Russell Berger | Bus., | Schuylkill Haven. |
| Borden, Robert Oswald | M.E., | Front Royal, Va. |
| Bowman, John Gheen | C.E., | Lansdale. |
| Brookfield, Frederic | Met., | Syracuse, N. Y. |
| Brooks, Charles Emery | M.E., | Glen Ridge, N. J. |
| Brown, Ernest Embich | E.E., | Lebanon. |
| Brown, Merritt Weaver | B.A., | Bethlehem. |
| Buck, Richard Joseph | B.A., | Bethlehem. |
| Bunn, George William | B.A., | East Stroudsburg. |
| Burke, Edmond Michael | C.E., | West Pittstown. |
| Burton, John Taylor | C.E., | Chestnut Hill. |
| Callow, Michael John | Met., | Salt Lake City, Utah. |
| Campbell, Andrew Hiestor | C.E., | Pottstown. |
| Castleman, Francis Lee, Jr. | B.A., | Philadelphia. |
| Chambers, Harold Bair | Met., | Lancaster. |
| Clothier, Conrad Fries | E.M., | Philadelphia. |
| Cohen, Milford Hersh | Ch.E., | Charleston, W. Va. |
| Colclough, William Frederick, Jr. | B.A., | Catasauqua. |
| Cook, Nevin John | B.A., | Drums. |
| Cottman, Llewellyn Powell | B.A., | Baltimore, Md. |
| Coulton, John Marshall | C.E., | Red Bank, N. J. |
| Croll, John Harold | E.M., | Steelton. |

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|---|---|---|
| Curtis, Edward Aloysius | E.E., | Lambertville, N. J. |
| Davis, James Hornor | B.A., | Clarksburg, W. Va. |
| Davis, Richard Light | E.M., | Lebanon. |
| Day, Hugh Taylor | B.A., | Philadelphia. |
| Dietrich, Horace Wilcox | C.E., | Baltimore, Md. |
| Dinkey, Charles Eugene, Jr. | E.M., | Pittsburgh. |
| Dorton, Frederick Babcock | B.A., | Baltimore, Md. |
| Douglass, Norman Engleman | Chem., | Baden. |
| Drury, William George | C.E., | West Pittston. |
| DuBois, Allen Corson | B.A., | Clayton, N. J. |
| Dudley, Thomas Underwood | Ch.E., | Middleburg, Va. |
| Dykes, Henry Victor dePuis | B.A., | Bethlehem. |
| Eames, George Monson, Jr. | B.A., | Bridgeport, Conn. |
| Egolf, Harry Louis, Jr. | E.M., | Philadelphia. |
| Emerson, Ralph Waldo | B.A., | Ridgefield Park, N. J. |
| Entrekin, Paul Brinton | E.M., | Swarthmore. |
| Everhart, John Lawrence | Ch.E., | Bethlehem. |
| Ewart, Roswell Horr | Ch.E., | North Plainfield, N. Y. |
| Feick, Rufus Daniel | Ch.E., | Kutztown. |
| Finegan, Paul James | B.A., | Burlington, N. J. |
| Fister, Lee Harold | E.E., | Reading. |
| Flory, Curtis Bertram | Bus., | East Orange, N. J. |
| Frey, Frank Gustave, Jr. | M.E., | Roland Park, Md. |
| Fullard, William George | B.A., | New York, N. Y. |
| Gairns, William Otto | Ch.E., | LaGrange, Ill. |
| Gallagher, Charles Barto | B.A., | Asbury Park, N. J. |
| Garra, Edward Joseph | B.A., | White Haven. |
| Geho, Charles Henry | Ch.E., | Allentown |
| Gibson, Kenneth Durward | Bus., | Belleville, N. J. |
| Goldstein, Sam | B.A., | Atlantic City, N. J. |
| Gondos, Robert Zoltan | Ch.E., | Philadelphia. |
| Green, Thomas Edgar | Bus., | Butler. |
| Greene, Henry Eckford, Jr. | Bus., | New York, N. Y. |
| Groner, Stephen Sheldon | Bus., | Syracuse, N. Y. |
| Gruhn, Arthur Max | Bus., | Brooklyn, N. Y. |
| Gyourko, Joseph Edward | M.E., | Eckley. |
| Harmon, Herbert Greason | E.M., | Ridgewood, N. J. |
| Hay, Erroll Baldwin, Jr. | M.E., | Mt. Airy. |
| Holzshu, Charles David | E.E., | Cumberland, Md. |
| Horn, Franklin Lefever | Bus., | Allentown. |

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|---|---|---|
| Howland, George Asbury | Ch.E., | Asbury Park, N. J. |
| Hursh, James Sharpe | Mar.E., | Newville. |
| Hutchinson, Stuart Buckley | C.E., | Bethlehem. |
| Isaacs, Kenneth Lothaire | M.E., | Scranton. |
| Jones, Edwin Pritchford | Bus., | Bellevue. |
| Jones, William Joseph | E.M., | Narberth |
| Keating, Miles James | Bus., | Bethlehem. |
| Keim, John Kenneth | M.E., | Bethlehem. |
| Keller, Edwin Walker | B.A., | Allentown. |
| Keller, Francis Randolph | E.E., | Allentown. |
| Kerr, Harry Knight | Ch.E., | Philadelphia. |
| King, Arthur Stanley | M.E., | Toms River, N. J. |
| Kingham, Lawrence Brewster | Bus., | East Orange, N. J. |
| Kinzie, Raymond Horatio | C.E., | Tamaqua. |
| Kirchner, Earl Lorenz | Ch.E., | Washington, D. C. |
| Kittinger, Spencer Colie | Bus., | Buffalo, N. Y. |
| Koegler, George Franz | B.A., | New York, N. Y. |
| Krazinski, Leo Charles | E.E., | Mahanoy City. |
| Krellberg, Alfred Street | Bus., | New York, N. Y. |
| Lambert, Ralph Arthur | E.M., | Bethlehem. |
| Lang, Elheim | Ch.E., | Phoenixville |
| Law, James Graham | Ch.E., | Bloomsburg. |
| Lawall, Paul | E.M., | Catasauqua. |
| Leavens, William Barry, Jr. | E.E., | Maplewood, N. J. |
| Lee, Russell Werner | Ch.E., | Ottawa, Ill. |
| Leib, James Fulton | Bus., | Baltimore, Md. |
| Lerch, Franklin Stuart | B.A., | Freemansburg. |
| Leshefka, George John | E.P., | St. Clair. |
| Levin, Nathan | M.E., | Trenton, N. J. |
| Levy, Maurice Burt | Met., | Hazleton. |
| Lewis, Robert | Bus., | Edgemer, L. I., N. Y. |
| Lingle, Charles Fitting | Bus., | Harrisburg. |
| Ludwig, Edward Henry | Ch.E., | Staten Island, N. Y. |
| Lundberg, George Otto | M.E., | Lansing, Mich. |
| MacFate, Robert Preston | Ch.E., | Bethlehem. |
| McKee, John Edwin | Ch.E., | Newport. |
| McMorris, William Barnhart | C.E., | Harrisburg. |
| Matthews, Armstrong Robertson | E.M., | Nashville, Tenn. |
| Mayberry, Harold | Bus., | Mahanoy City. |
| Metten, William Murray | Bus., | Wilmington, Del. |

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| Miller, Howard Frederick | M.E., | Easton. |
| Miller, William Hurxthal | E.E., | Glendale, O. |
| Minster, Pemberton Foster | Bus., | Bristol. |
| Moran, Eugene Francis, Jr. | Mar.E., | Brooklyn, N. Y. |
| Moritz, George Robert | Met., | Allentown. |
| Myers, John Alfred | M.E., | York. |
| Neely, Rodgers | B.A., | Ben Avon. |
| Nehemiah, Maurice Albert | Ch.E., | Brooklyn, N. Y. |
| Nicola, Oliver Peter, Jr. | E.M., | Pittsburgh. |
| Noerr, Robert Collyer, Jr. | Ch.E., | Hartford, Conn. |
| O'Brien, William Coleman | E.E., | Washington, D. C. |
| Orr, Earl Haas | Met., | Lansdale. |
| Palmer, Arthur Carl | C.E., | New York, N. Y. |
| Palmer, Herbert William | B.A., | Pen Argyl. |
| Parker, Norman Douglas | E.E., | Washington, D. C. |
| Paxton, George Benjamin | M.E., | Harrisburg. |
| Pfaffhausen, Herbert Lee | M.E., | Union Hill, N. J. |
| Pharo, Homer Durand | Chem., | Bayonne, N. J. |
| Philips, Harry Kenneth | Bus., | Glen Ridge, N. J. |
| Pilat, William James | B.A., | New York, N. Y. |
| Pineda, Louis Guillermo | E.E., | Maracaibo, Venezuela. |
| Pittenger, Harry Joseph | E.M., | Bethlehem. |
| Platt, Ellis Halsted | B.A., | Washington, D. C. |
| Polatchek, Jerome Julius | E.M., | New York, N. Y. |
| Porter, Clarence Henry | M.E., | Washington, D. C. |
| Purdy, Victor Moreau | Met., | Brooklyn, N. Y. |
| Rankin, Bryant Loose | Met., | Reading. |
| Ransom, James Dudley | B.A., | Jersey City, N. J. |
| Reid, William Alexander | M.E., | Glen Ridge, N. J. |
| Rice, Mark Samuel | Bus., | Bethlehem. |
| Roberts, Carlton Mitchell | C.E., | Asbury Park, N. J. |
| Roberts, Paul Eagon | B.A., | Parkersburg, W. Va. |
| Rorabough, Merrill Schaeffer | E.E., | New Kensington. |
| Ross, Rodney Wyckood | Bus., | Asbury Park, N. J. |
| Rostow, Lawrence | Chem., | Newark, N. J. |
| Samuels, Fred Herman | B.A., | Bethlehem. |
| Saxton, Eugene Harris | Bus., | Jersey City, N. J. |
| Schlicht, William Michael | Bus., | Bethlehem. |
| Schock, Harvey Harold | Chem., | Shartlesville. |
| Seely, Robert Inglish | C.E., | Keansburg, N. J. |

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|---|---|---|
| Senior, Palmer Newman | E.M., | Bridgeport, Conn. |
| Shartle, John Herbert | C.E., | Lancaster. |
| Siebert, John Carl | Met., | Coopersburg. |
| Siegmund, Harry Loew | Ch.E., | Harrisburg. |
| Smith, Morris Sparhawk | M.E., | Swarthmore. |
| Smith, Walter Reynolds | B.A., | Carbondale. |
| Springsteen, William Watson | Bus., | Detroit, Mich. |
| Stahl, Harry Ernest | B.A., | Trenton, N. J. |
| Stauffer, Willis Keiter | E.E., | Bethlehem. |
| Stazinski, Peter Felix | M.E., | Plymouth. |
| Stelle, Kenneth Lawrence | Bus., | Jamaica Plain, Mass. |
| Stott, Frank Janney | Bus., | Philadelphia. |
| Su, Harry Fang Piu | E.M., | Amoy, China. |
| Swank, Dallas Lester | E.M., | Binghampton, N. Y. |
| Taylor, Robert Sayre | B.A., | Bethlehem. |
| Taylor, Thomas Frederic | C.E., | Bangor. |
| Thomas, Hopkin Buckland | M.E., | Catasauqua. |
| Trumbore, Clarke Richard | B.A., | Bethlehem. |
| Trushel, William Carl | B.A., | Warren. |
| Tuggey, John Mitchell | B.A., | Bethlehem. |
| Tyler, Walter Simeon | Chem., | Bethlehem. |
| Underwood, Lloyd Fletcher | Chem., | Chatham, N. J. |
| VanNostrand, Erwin Skidmore | M.E., | Toms River, N. J. |
| Verlenden, John Boyd | C.E., | Darby. |
| Volkmar, Karl | C.E., | Williamsport. |
| Walker, William Higham | E.M., | Riverside, N. J. |
| Wallace, Kenneth Campbell | Chem., | Bridgeport, Conn. |
| Wardell, Weston Burnet | Bus., | East Orange, N. J. |
| Washburn, Lindsley Morgan | Bus., | Wilkes-Barre. |
| Weissenborn, Albert Edward | E.M., | Montclair, N. J. |
| Welch, Heister Jacob | Mar.E., | Elmira, N. Y. |
| Wetterau, Paul Christian | Chem., | Hazleton. |
| Wilson, Lorenz Henry | M.E., | Wilmington, Del. |
| Wolcott, Leslie Carl | E.E., | Warren, O. |
| Wurster Luther Conrad | E.E., | Harrisburg. |

## SOPHOMORE CLASS

### Class of 1926

| *Name* | *Curriculum* | *Residence* |
|---|---|---|
| Abel, David Heaton | B.A., | Ogontz. |
| Adams, Robert Burnette | Bus., | Brockton, Mass. |
| Allard, Charles Norman | Ch.E., | Wildwood, N. J. |
| Althouse, Ernest Emmanuel | E.E., | Hamburg. |
| Ambler, Charles Merrill | Bus., | Abington. |
| Anderson, Paul Sutro | Bus., | Westfield, N. J. |
| Applegate, William McLean | E.E., | Red Bank, N. J. |
| Argens, Richard George | B.A., | San Francisco, Cal. |
| Ash, Charles Elwood, Jr. | M.E., | Kingston. |
| Ayres, Elwood Bowers, Jr. | M.E., | Melrose Park. |
| Bachman, George, Jr. | C.E., | Camden, N. J. |
| Bachman, Joseph Peter, Jr. | Bus., | Allentown. |
| Barnes, John Francis | E.M., | New Platz, N. Y. |
| Bayard, Arnold Aaron | M.E., | Philadelphia. |
| Bell, Davitt Stranhan | M.E., | Pittsburgh. |
| Bidwell, James Truman | B.A., | Portland, Ore. |
| Bigley, James Warren | E.E., | Kingston. |
| Binai, Rong | Ch.E., | Washington, D. C. |
| Bishop, Bruce Hunter | M.E., | Scranton. |
| Bissinger, John Abraham | M.E., | Harrisburg. |
| Bond, Nelson Leighton | Bus., | Caldwell, N. J. |
| Borneman, Walter Houck | E.E., | Millville, N. J. |
| Boush, Gilbert Wesley | E.M., | Harrisburg. |
| Bridge, Ernest Laithwaite | B.A., | Glen Ridge, N. J. |
| Brinser, Donald Christian | B.A., | Harrisburg. |
| Britt, Therman Paul | Bus., | Rydal. |
| Broome, Ross Alexander | Bus., | Scranton. |
| Brown, LeRoy Augustus | C.E., | Allentown. |
| Brown, Willard Marshall | Ch.E., | Palmerton. |
| Buell, David Clinton, Jr. | E.M., | Middletown, N. Y. |
| Buenning, Carl Anthony | E.E., | Easton. |
| Burgess, Henry Russell | C.E., | Pittsburgh. |
| Bushar, Harold Gordon | C.E., | Pottsville. |
| Canfield, Donald | Bus., | Caldwell, N. J. |
| Case, Rowland Bertram | M.E., | Phillipsburg, N. J. |
| Cetina, Renan | E.E., | Labasco, Mexico. |

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|---|---|---|
| Cheel, Robert Duncan | M.E., | Ridgewood, N. J. |
| Chew, Edmund Freeman | M.E., | Mantua, N. J. |
| Childs, Frank Lawton | Bus., | New York, N. Y. |
| Childs, James Lawton | Bus., | New York, N. Y. |
| Comstock, Clinton Samuel | M.E., | Ridgewood, N. J. |
| Coopersmith, Charles | C.E., | Philadelphia. |
| Corson, Osman Myron | E.E., | Cape May Court House, N. J. |
| Cottman, William Watson | M.E., | New Hope. |
| Craig, John Harner | Ch.E., | Slatington. |
| Cressman, Paul Kreidler | B.A., | Bethlehem. |
| Cresswell, Herbert | M.E., | Scranton. |
| Cryder, William Adams | Bus., | Berwick. |
| Cumming, Benjamin Wilson | Bus., | Pottsville. |
| Cyphers, Kenneth Alexander | M.E., | Bethlehem. |
| Dalgleish, Robert Hamilton | M.E., | Washington, D. C. |
| Dancy, John Lloyd | E.E., | Phoenixville. |
| Davis, Clyde | Bus., | Pittsburgh. |
| Deck, Ausben Riege | Ch.E., | Dover, N. J. |
| DeLong, William Fox | E.E., | Philadelphia. |
| DeWitt, William Carpenter | M.E., | Phillipsburg, N. J. |
| Dutt, Loris Merritt | B.A., | Bangor. |
| Dwyer, William Joseph | Bus., | Bethlehem. |
| Dyson, Robert Harris | E.E., | Washington, D. C. |
| Eagleton, Sterling Paul | M.E., | Cleveland, O. |
| Earle, John Goldsborough | Mar.E., | Easton, Md. |
| Elliott, Lewis Charles, Jr. | C.E., | York. |
| Ellis, Franklin Griffith | Ch.E., | Allentown. |
| Elmer, Robert William | E.E., | Bridgeton, N. J. |
| Evans, Merle Robert | E.M., | Ebensburg. |
| Faga, Edgar Monroe | Bus., | Bethlehem. |
| Flammer, Russell Bernhard | Bus., | Bethlehem. |
| Forsyth, William Redway | C.E., | Trenton, N. J. |
| Fouchaux, Julien Ellis | E.E., | Paterson, N. J. |
| Fountain, Robert Freeder, Jr. | Bus., | South River, N. J. |
| Fraivillig, Leonard Martin | C.E., | Bethlehem. |
| Frank, Robert Louis | B.A., | Johnstown. |
| Frasca, Modestino John | B.A., | Stamford, Conn. |
| Freeman, Robert Edgar | Bus., | Camden, N. J. |

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| Fulton, Arthur Logan | B.A., | Catasauqua. |
| Gibb, John Valentine | E.E., | Haddon Heights, N. J. |
| Giles, Edward Maynard | Ch.E., | Paterson, N. J. |
| Glass, Samuel Kenelm | Bus., | Philadelphia. |
| Glenn, Graeff William | M.E., | Elkins Park. |
| Godshalk, Gerald Desmond | E.M., | Lansdale. |
| Gordon, Malcolm Kenneth, Jr. | E.P., | New York, N. Y. |
| Gorgas, Charles Crawford | Bus., | Paterson, N. J. |
| Greer, William Chamberlain, Jr. | Bus., | Woodbury, N. J. |
| Grieb, Conrad Keital | E.E., | Baltimore, Md. |
| Griesmer, David Elias | M.E., | Allentown. |
| Gunther, Frank Joseph | Bus., | Brooklyn, N. Y. |
| Haas, Charles Francis | E.E., | New York, N. Y. |
| Haefeker, George Augustus | B.A., | Tamaqua. |
| Halteman, Austin Shaffer | C.E., | Allentown. |
| Harley, John Stott | M.E., | Coatesville. |
| Harris, Abraham Buckley | Ch.E., | Baltimore, Md. |
| Harris, Arthur Digby | C.E., | Hackensack, N. J. |
| Harris, Murray Duncan | E.M., | Marquette, Mich. |
| Hayes, Daniel Frank | E.E., | Paterson, N. J. |
| Heath, Donald Austin | E.M., | Jersey City, N. J. |
| Hendershott, Harold Clark | E.M., | Newton, N. J. |
| Henke, Herman John | E.E., | Honesdale. |
| Henry, Alvan LeRoy | Bus., | Flemington, N. J. |
| Henry, Gerald Boyd | B.A., | Buffalo, N. Y. |
| Hess, Harry Charles | Bus., | Massillon, O. |
| Hess, Howard Samuel | Bus., | Hellertown. |
| Hoffman, Kenneth Landes | E.E., | Ventondale. |
| Hornbaker, Donald Griffin | M.E., | Clarks Summit. |
| Hubbard, Sheldon Crouter | E.M. | Palma Sola, Fla. |
| Hunter, Joseph Eastham | Ch.E., | Jenkintown. |
| Huyette, Samuel Louis | Bus., | Germantown. |
| Jackson, Joseph Gray | Ch.E., | Bala Cynwyd. |
| Jedlicka, Frank Eugene | E.E., | Baltimore, Md. |
| Jennings, Albert Edward | C.E., | Bethlehem. |
| Kear, Frank Gregg, Jr. | E.E., | Minersville. |
| Keen, Frank Porter | Bus., | Baltimore, Md. |
| Keller, Charles Ferdinand | Ch.E., | Harrisburg. |
| Kennedy, Richard Morris | E.E., | Lansford. |

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|---|---|---|
| Kenworthy, William Bortle | B.A., | Philadelphia. |
| Kiefer, Elmer Joseph, Jr. | M.E., | Stroudsburg. |
| King, Frederick William Forbes | M.E., | Glen Head, N. Y. |
| Knerr, Russell Peter | B.A., | Allentown. |
| Kutz, Samuel Edward | M.E., | Easton. |
| Laramy, William John | E.M., | Altoona. |
| Law, Hartland | Ch.E., | Camden, N. J. |
| Lesh, Stogdell Stokes | E.E., | South River, N. J. |
| LeVan, James Henry | C.E., | Minersville. |
| Levitz, Max | Bus., | New York, N. Y. |
| Lewin, Henry | Bus., | Malden, Mass. |
| L'Hommedieu, Paige Drake | Bus., | New Brunswick, N. J. |
| Linck, Robert Charles | C.E., | Philadelphia. |
| Lister, William Harry | M.E., | Rockville Centre, N. Y. |
| Loebell, Richard E. | Ch.E., | Long Island, N. Y. |
| Long, George Davis | C.E., | Bolivar. |
| Lucente, Romeo Julius | Bus., | Bethlehem. |
| McCance, Edward Gilmour | B.A., | Bethlehem. |
| McCormick, Neil James | Met., | Bethlehem. |
| McCullough, Walter Homer | C.E., | Vandergrift. |
| McFarlan, Alden Irving | M.E., | Bayonne, N. J. |
| McGurl, Gilbert Vincent | Ch.E., | Minersville. |
| McKenzie, Alfred Crane | B.A., | Brooklyn, N. Y. |
| McKenzie, Frank Russell | M.E., | Brooklyn, N. Y. |
| McWilliams, C. Anthony Sinclair | Mar.E., | New York, N. Y. |
| Mackey, Theodore William | E.E., | Bethlehem. |
| Maiese, Domenick | E.E., | Camden, N. J. |
| Manuel, David Fuller | C.E., | Philadelphia. |
| Mapes, Harold Edward | Bus., | Glen Ridge, N. J. |
| March, Robert Carl Richard | E.E., | Philadelphia. |
| Mastriani, Samuel Gabriel | C.E., | Dunmore. |
| Mattern, Robert Jones | Bus., | Huntingdon. |
| Maxwell, John Walter, Jr. | Mar.E., | Philadelphia. |
| Meden, Frederick Elof | E.E., | Chatham, N. J. |
| Mell, William Harvey | C.E., | Roanoke, Mo. |
| Mercer, Frederic | B.A., | Hazleton. |
| Merrill, Howard Elwood | B.A., | Garrett. |
| Meyers, Edgar Janvier | E.E., | Bridgeton, N. J. |
| Meyers, William Earl | Bus., | East Stroudsburg. |

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|---|---|---|
| Miller, Gordon Blair | Bus., | Huntingdon. |
| Miller, William James | Bus., | Bethlehem. |
| Mong, Donald McMillan | E.E., | Erie. |
| Montverde, Francis | E.E., | Lambertvile, N. J. |
| Moreland, Lester Duane | M.E., | Trenton, N. J. |
| Morris, James Reed, Jr. | Bus., | Pittsburgh. |
| Morris, Stanford Runyan | E.M., | Bristol. |
| Morrison, James Robert Burns | M.E., | Auburn. |
| Murray, William Elmer, Jr. | M.E., | Louisville, Ky. |
| Nagel, George Samuel | E.E., | Abbottstown. |
| Nicholas, Charles William | B.A., | Butler. |
| Nicholls, Edward Samuel | Ch.E., | Bethlehem. |
| Norton, Robert Osgood | M.E., | South Orange, N. J. |
| Olwine, John Clayton | Ch.E., | Newark, N. J. |
| Osborn, Howard Milton | E.E., | Vineland, N. J. |
| Oswald, Ernest Paul | M.E., | Lancaster. |
| Pakenham, Edward Dudley | B.A., | Brooklyn, N. Y. |
| Partridge, Harvey Helsey, Jr. | B.A., | Merchantville, N. J. |
| Patty, Clairbourne Watkins | E.M., | Little Rock, Ark. |
| Pease, George Warren | Bus., | Ridgewood, N. J. |
| Pease, Morris Gabriel | M.E., | Steelton. |
| Perry, John Richard Pattison | E.E., | Centreville, Md. |
| Phillips, Forrest Edwin | Chem., | Bethlehem. |
| Phyfye, Herbert Lloyd | C.E., | New York, N. Y. |
| Pierce, Ira Elford | E.E., | Peckville. |
| Platt, Worthington Elmore | E.M., | New Haven, Conn. |
| Poliska, Stephen George | C.E., | Taylor. |
| Pollack, Edward Wells | Bus., | New York, N. Y. |
| Presbrey, Clifton Hyde | E.M., | Arlington, N. J. |
| Price, Joseph Christian | C.E., | Philippine Islands. |
| Prior, Charles Malcolm | Bus., | Ridgewood, N. J. |
| Purcell, William Wendell | C.E., | Plainfield, N. J. |
| Pursel, Robert Newton | M.E., | Danville. |
| Randles, Merritt Emmet | Met., | Ogdensburg, N. Y. |
| Rankin, William Price | Ch.E., | Phoenixville. |
| Rapp, Howard Heath | B.A., | Philadelphia. |
| Rathbone, William Vinton | Chem., | Parkersburg, W. Va. |
| Rebman, Henry Bertram | E.E., | Philadelphia. |
| Reinoehl, John Benjamin | Bus., | Tremont. |

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|---|---|---|
| Rerig, Eugene Lyons | E.E., | Hazleton. |
| Reush, Walter George | Bus., | New York, N. Y. |
| Reynolds, Thomas Francis | M.E., | Bethlehem. |
| Rice, Hugh Banker | C.E., | Roanoke, Va. |
| Rich, Herbert William | E.M., | East Orange, N. J. |
| Richman, Edwin | E.E., | Haddon Heights, N. J. |
| Rigg, Edward Fletcher | Bus., | Burlington, N. J. |
| Roberts, John Eldon | Bus., | Buffalo, N. Y. |
| Robinson, Hugh Wilson | Bus., | Bethlehem. |
| Robinson, Thomas Edmond | B.A., | Trenton, N. J. |
| Rowley, Thomas Clarence | Met., | New York, N. Y. |
| Rush, Frank Schuyler | B.A., | Southampton, N. J. |
| Sall, George Leonard | Bus., | Philadelphia. |
| Samuels, Fred Herman | B.A., | Newark, N. J. |
| Sauerbrun, Irving Nelson | C.E., | Elizabeth, N. J. |
| Schatz, George Whenhold | E.E., | Allentown. |
| Schmidt, John Henry | M.E., | Millington, N. J. |
| Schmoyer, Paul William | B.A., | Bethlehem. |
| Scholly, Francis Royden | Bus., | Allentown. |
| Schneider, Robert Siis | M.E., | New York, N. Y. |
| Schroeffel, John Bishop | M.E., | Camden, N. J. |
| Schwartz, Siegmund Philip | E.E., | Bridgeport, Conn. |
| Schwimmer, Herman Victor | Bus., | Brooklyn, N. Y. |
| Schule, Frank Frederick | Bus., | Brooklyn, N. Y. |
| Scott, Wilson Winfield, Jr. | E.E., | Catasauqua. |
| Scrivener, Samuel, Jr. | E.M., | Washington, D. C. |
| Seaman, Herbert Henderson | Bus., | Plainfield, N. J. |
| Seely, Harold Morris | Bus., | Keansburg, N. J. |
| Seeman, Fred Charles | E.E., | Roland Park, Md. |
| Serrell, Arthur Harold | M.E., | Brooklyn, N. Y. |
| Shaheen, Philip Joseph | Bus., | Cranford, N. J. |
| Shellenberger, John | M.E., | Bayonne, N. J. |
| Sheppard, Kenneth Anthony | C.E., | Bridgeton, N. J. |
| Shipley, Herbert Mapes | E.E., | Brooklyn, N. Y. |
| Sholes, Charles Latham | Bus., | Short Hills, N. J. |
| Shoupe, Raymond Arthur | E.E., | Reading |
| Shuhart, John Henry | E.E., | Bethlehem. |
| Smith, Charles Edward | Ch.E., | Bethlehem. |
| Smith, Frederick Calvin | B.A., | Pen Argyl. |

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|---|---|---|
| Smith, Gilbert Robert | E.E., | Jeddo. |
| Snyder, William Cordes | E.M., | Snow Shoe. |
| Spalding, Fitzhugh Preston | M.E., | Kennett Square. |
| Sparks, Robert | E.E., | Far Rockaway, N. Y. |
| Spiehler, Augustine Merle | Bus., | Rochester, N. Y. |
| Stein, Emil | B.A., | Bethlehem. |
| Stephens, Fred James | C.E., | Elizabethtown. |
| Stevens, William Ronald | C.E., | Hackensack, N. J. |
| Stofan, Andrew | B.A., | Eckley. |
| Stofflet, Millard Abraham | B.A., | Nazareth. |
| Stoer, John Waddell | Bus., | Wheeling, W. Va. |
| Stover, Arthur Platt | Ch.E., | Wilmington, Del. |
| Taylor, Charles Gibson | E.E., | Pittsburgh. |
| Thorpe, Gardner Belknap | Bus., | Babylon, N. Y. |
| Trainer, Robert Leonard | C.E., | Irvington, N. J. |
| Travis, Frank Glen | Bus., | Pittsburgh. |
| Travis, John Thurston | B.A., | Paterson, N. J. |
| Unkles, John Jacob | Bus., | East Orange, N. J. |
| Varga, Vincent Ignatius | C.E., | Bethlehem. |
| Vennel, Charles Reed | Bus., | Camden, N. J. |
| Visintainer, Alfred A. | C.E., | Mt. Carmel. |
| Waesche, William Henry, Jr. | Bus., | Baltimore, Md. |
| Waldron, John Wesley | Chem., | Philadelphia. |
| Walters, Emerson LeRoy | Bus., | Bethlehem. |
| Waltman, John Richard | E.M., | Bethlehem. |
| Warlow, Stanley Thomas | B.A., | Williamstown. |
| Washington, William deHertburn | E.E., | Riverton, N. J. |
| Waters, Walter Brittain | B.A., | Newark, N. J. |
| Watson, Charles Wilbur | E.E., | Madison, N. Y. |
| Watters, John Waldner | B.A., | Ashland. |
| Weaver, Russell | C.E., | Allentown. |
| Weinstein, Benjamin | B.A., | Philadelphia. |
| Wetzel, Roland Martz | B.A., | Bethlehem. |
| White, Henry Brooks | E.M., | Philadelphia. |
| Widdowfield, William Crippen | E.E., | Clark's Green. |
| Williams, L. Augustine Peter | E.E., | Woodstock, Vermont. |
| Williamson, Henry Thelbert | Bus., | Phillipsburg, N. J. |
| Wilmot, George Lincoln | Met., | Hazleton. |
| Winchester, Robert Caskey | B.A., | Phoenixville. |

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|---|---|---|
| Wintermute, Gerald Hiks | E.E., | Newton, N. J. |
| Zug, Charles Keller | E.E., | Philadelphia. |
| Zurn, Oliver Franklin | Ch.E., | Philadelphia. |

## FRESHMAN CLASS

### Class of 1927

| *Name* | *Curriculum* | *Residence* |
|---|---|---|
| Ake, Theodore | Met., | Canton, O. |
| Alden, Charles Whiting | E.M., | Steelton. |
| Alexander, John Barnet Leigh | E.E., | Delaware Water Gap. |
| Allen, John Bolen, Jr. | C.E., | Washington, D. C. |
| Ames, Charles Savage | B.A., | Scranton. |
| Anderson, Frank George | E.E., | Takoma Park, Md. |
| Arnold, Edwin Brown | B.A., | Pittsburgh. |
| Ashcraft, Edward Davis | E.E., | Mullica Hill, N. J. |
| Askin, Joseph Samuel | Bus., | Brooklyn, N. Y. |
| Aykroyd, Marshall John | Bus., | Bethlehem. |
| Azpurua, Fernando Capriles | C.E., | Puerto Cabello, Venz. |
| Bailey, Walter Conrad, Jr. | Bus., | Germantown. |
| Baker, Ralph William | Ch.E., | Roanoke, Va. |
| Ball, Russell | B.A., | Roanoke, Va. |
| Bambas, Stephen Walter | B.A., | Simpson. |
| Barba, Charles Elmer | M.E., | Newton, Mass. |
| Barr, John Hope Sloan | M.E., | Wayne. |
| Barron, Elwood M. | Ch.E., | Peermont, N. J. |
| Barrowclough, Kirk McCarter | C.E., | Chester. |
| Bartoo, Elfred Garrett | C.E., | Ridgewood, N. J. |
| Bascom, Warren Broughton | C.E., | Allentown. |
| Beans, John James | Bus., | Wheeling, W. Va. |
| Beck, Robert Lewis | M.E., | Millville, N. J. |
| Beggs, George Harper | E.E., | Reading. |
| Bennicoff, Lewis George | C.E., | Allentown. |
| Bentz, Gene Walter | B.A., | Mill Hall. |
| Berger, Clyde Alvin | E.E., | Palmerton. |
| Best, Clarence Stephen | B.A., | Allentown. |
| Bester, Harold Frederick | Bus., | Hagerstown, Md. |
| Bingle, Francis Xavier | Bus., | New York, N. Y. |
| Birley, Frederick Adam | E.E., | New Oxford. |

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|---|---|---|
| Bittrich, Carl Louis | Met., | Bethlehem. |
| Bletz, Ira Mellinger | E.E., | Columbia. |
| Bloor, Ralph Loveland | Ch.E., | Trenton, N. J. |
| Board, Cornelius Zabriskie | E.E., | Ridgewood, N. J. |
| Bogart, Louis | Bus., | New York, N. Y. |
| Borchers, Harry John | Bus., | Huntington, N. Y. |
| Bowler, Charles Wilbur | M.E., | Glenside. |
| Boyd, Oliver Kreger | B.A., | Monessen. |
| Brandon, Ford Campney | Met., | Beaver Falls. |
| Bricker, George Krall | E.E., | York. |
| Bridewell, Charles Fielding | C.E., | Pittsburgh. |
| Britton, Challis | E.E., | Scranton. |
| Broad, Lambert Edward | B.A., | Nazareth. |
| Broads, Irving | B.A., | Yonkers, N. Y. |
| Brooks, James Richard | Bus., | Miami, Fla. |
| Browell, Jack Nelson | Bus., | Palmerton. |
| Brown, Carlton Ernest | Ch.E., | Washington, D. C. |
| Brown, Charles Walker, Jr. | Ch.E., | Bethlehem. |
| Brown, Harry Arthur | Ch.E., | Lebanon. |
| Brown, William Nicholas | E.E., | Brooklyn, N. Y. |
| Burkhardt, Louis Hoddle, Jr. | M.E., | Warren. |
| Burnham, William | Bus., | New York, N. Y. |
| Bush, Rudolph Myers | C.E., | Washington, D. C. |
| Butz, Richard James | Ch.E., | Allentown. |
| Campbell, James Edward | Ch.E., | Oyster Bay, N. Y. |
| Canney, Arthur Warren | M.E., | Paterson, N. J. |
| Cannon, William, Jr. | Bus., | Bridgeville, Del. |
| Carmichael, Hilton Thomas | B.A., | New Haven, Conn. |
| Cassel, Charles Harold | M.E., | Lansdale. |
| Castor, Norman Richard | C.E., | Philadelphia. |
| Cawley, Francis Ferris | B.A., | Archbald. |
| Chacey, Jouett Allen | Mar.E., | Paterson, N. J. |
| Chadwick, Howard Cornelius | Bus., | Woodbury, N. J. |
| Chase, Robert Gorden | Bus., | Clark's Summit. |
| Chiles, Franklin Groman | Ch.E., | Bethlehem. |
| Chiodo, Leo Joseph | E.E., | Dunmore. |
| Clark, Roger Conant | M.E., | Canton, O. |
| Glass, Charles Frank, Jr. | C.E., | Paxtang. |
| Clement, John Sullivan | B.A., | Williamansett, Mass. |

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| Cohen, Milton Harvey | Bus., | Lewistown. |
| Cohen, Marcus Ovid | M.E., | Washington, D. C. |
| Concilio, Vito Angelo | Ch.E., | Newton, N, J. |
| Conneen, Andrew Martin | M.E., | Maplewood, N. J. |
| Conrad, Harrison Whittingham | C.E., | New York, N. Y. |
| Converse, Curtis Vaughn | Bus., | Athens. |
| Cooke, Theodore, 3rd | Bus., | Pikesville, Md. |
| Coombe, William Thomas | Bus., | Bethlehem. |
| Cooper, Frank Edward | C.E., | Shamokin. |
| Cooper, William Charles | C.E., | Shamokin. |
| Couch, Leonard Hugenor | Bus., | Buffalo, N. Y. |
| Covert, John Addison | C.E., | Pittsburgh. |
| Cowan, Frank Bertine | E.E., | Long Island, N. Y. |
| Cowan, Theodore Mayham | B.A., | Glen Cove, N. Y. |
| Cox, John Philip | E.M., | Leonia, N. J. |
| Crane, Richard Taylor | Bus., | Belmont, N. J. |
| Crawford, Frederick Rufus | B.A., | Pittsburgh. |
| Croxton, John Coventry | Bus., | Cleveland, O. |
| Cunningham, Davis Schreiber | E.M., | Ben Avon. |
| Danzilio, Barton Cannon | B.A., | St. George, S. I., N. Y. |
| DeGray, Richard John | Ch.E., | Ramsey, N. J. |
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| DeMotte, Howard Douglas | E.E., | Hackensack, N. J. |
| DeMoyer, John William, Jr. | E.E., | Camden, N. J. |
| Diener, John Bertram | M.E., | Hamburg. |
| Dietrich, Henry Buckley | Bus., | Baltimore, Md. |
| Dietrich, Noah Donald | Bus., | Bethlehem. |
| Doll, Frederick Tilghman | B.A., | Allentown. |
| Doty, George Edward, Jr. | Bus., | Peekskill, N. Y. |
| Draper, William Cortell | Bus., | Toledo, O. |
| Dunn, Robert Clarence | Bus., | Park Ridge, N. J. |
| Dwyer, William Francis, Jr. | E.E., | Easton. |
| Eckstein, Mortimer Lazar | B.A., | Trenton, N. J. |
| Elliott, Marshall | E.E., | Marcus Hook. |
| Ely, Paul Coughanour | Met., | Monessen. |
| Estevez, Fernando Eucibio | C.E., | Chester. |
| Evans, Edward Whiting | M.E., | Brooklyn, N. Y. |
| Ewertz, Gordon Eric | E.E., | Elizabeth, N. J. |

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| Farrell, James Henry, Jr. | E.M., | Centralia. |
| Fear, Robert Emmett | E.E., | Pittston. |
| Ferris, Irvin Miester | B.A. | Westfield, N. J. |
| Feuerbach, William Ferdinand | Bus., | Richmond Hill, N. Y. |
| Finlay, Jack Pearce | B.A., | Redlands, Cal. |
| Fisher, Frederick Mertz | Ch.E., | Wyoming. |
| Fister, Harold John | Ch.E., | Allentown. |
| Fitch, Charles Perkins | E.M., | Asbury Park, N. J. |
| Fluck, Robert William | E.E., | Allentown. |
| Forbes, Joseph Palmer | C.E., | Chambersburg. |
| Ford, John Albert | B.A., | Phoenixville. |
| Ford, John Simpson | E.M., | Houston, Texas. |
| Forman, Maurice | Bus., | Rochester, N. Y. |
| Fort, George Lafayette | Met., | Minneapolis, Minn. |
| Frauenheim, Richard Joseph | Bus., | Pittsburgh. |
| French, James Ralph | E.E., | Oil City. |
| Frey, Julian Jordan | Bus., | Baltimore, Md. |
| Friebely, Carl Daniel | Bus., | Bethlehem. |
| Fuller, Charles Rawson | B.A., | Flushing, N. Y. |
| Fulton, David Mercier | Bus., | Baltimore, Md. |
| Furnival, George Edward | E.E., | Philadelphia. |
| Garcia, Emilio | M.E., | New York, N. Y. |
| Garrison, John Hazlett | M.E., | Pittsburgh. |
| Gerlach, Lewis Jacob | B.A., | Bethlehem. |
| Gessner, Charles Booth | C.E., | Toledo, O. |
| Getz, Benjamin Leo | Bus., | Allentown. |
| Gisriel, John Walker, Jr. | Met., | Baltimore, Md. |
| Glocker, Rudolph Karl | B.A., | Graterford. |
| Goodfellow, Owen Davis | M.E., | Coatesville. |
| Gordon, Perry Westcott | C.E., | Allentown. |
| Gould, William | E.M., | Brooklyn, N. Y. |
| Gray, James Mitchell | Bus., | Middletown, N. Y. |
| Greenberg, David | B.A., | Bethlehem. |
| Gresh, Walter Sutrum | E.E., | Hummeltown. |
| Griffith, Charles Beall | M.E., | Washington, D. C. |
| Grunwell, Gilbert Butterfield | C.E., | Pineta Gorda, Fla. |
| Gualco, John George | Bus., | Mauch Chunk. |
| Guerrero, Luis Francisco | E.M., | Brooklyn, N. Y. |
| Gutowitz, Herman Joseph | B.A., | Amityville, N. Y. |

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| Halls, Norman Winston | B.A., | Youngstown, O. |
| Hamrah, Elias Alexander | Bus., | Brooklyn, N. Y. |
| Hanna, Charles Warren | Ch.E., | Crawford, N. J. |
| Hanlon, James Paul | E.E., | Freeland. |
| Harrier, Robert Austin | E.M., | LaCrosse, Wis. |
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| Hartke, John Joseph, Jr. | E.E., | Elkridge, Md. |
| Harvey, Wilbur Edward | Met., | Catasauqua. |
| Hawkins, Wallace Randolph | C.E., | Gloucester City, N. J. |
| Hayes, John Boniface | B.A., | New Britain, Conn. |
| Heaton, Percy Hugh | Ch.E., | Reading. |
| Hedenberg, George Dubois, Jr. | M.E., | Milton. |
| Heil, Clinton Franklin | B.A., | Bethlehem. |
| Heine, Laurence Joseph | E.E., | Bethlehem. |
| Heller, Rogers Stephen | M.E., | Stroudsburg. |
| Herrera, Jose Uslar | C.E., | New York, N. Y. |
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| Higginbottom, William Eric | M.E., | Baltimore, Md. |
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| Hoffman, Harry Swartzlander | E.E., | Yardley. |
| Hoffman, John Albert | C.E., | Fleetwood. |
| Holloway, Albert Marks | B.A., | Alden Station. |
| Holmes, John Middleton | Met., | New York, N. Y. |
| Hood, George Washington | Bus., | Weehauken, N. J. |
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| Hoover, Dudley Allen | B.A., | Buffalo, N. Y. |
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| Hosking, Herbert Tage | Chem., | Philadelphia. |
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| Huckins, George | E.M., | Kaukakee, Ill. |
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| Jacobs, Harry Joseph | Bus., | Hammonton, N. J. |
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| Jochum, Albert | Bus., | Richmond Hill, N. Y. |
| Johnsen, Ernest Andrew | Chem., | Warren. |
| Johnson, James Dunlap | Bus., | Vingina, Va. |

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| Jones, Walter Theodore | B.A., | Bath. |
| Kanasut, Dien | M.E., | Washington, D. C. |
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| Keller, Eugene Alvin | M.E., | Takoma Park, D. C. |
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| Kennedy, George Frederick | C.E., | Lansford. |
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| Kent, Lewis Shaw | Bus., | Upper Montclair, N. J. |
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| Ketterrer, Paul Elmer | Bus., | Butler. |
| Kinn, Edwin William | M.E., | West Hoboken, N. J. |
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| Kittinger, Irvine Johnston, Jr. | Bus., | Buffalo, N. Y. |
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| Knipe, Septimus Leon | C.E., | New Hanover. |
| Kost, Edward Paul | Met., | Bethlehem. |
| Krey, Norman Louis | Ch.E., | Washington, D. C. |
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| Kuck, George Justus | B.A., | New York, N. Y. |
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| Lake, Edward Earl | Bus., | Perth Amboy, N. J. |
| Lambert, Herbert Schrock | Bus., | Somerset. |
| Lang, George Isaac | Bus., | Brooklyn, N. Y. |
| Laudenbach, Herman Henry | B.A., | Nazareth. |
| Leach, Francis Arthur | B.A., | Orange, Mass. |
| Lear, Caesar Clinton | Bus., | Bethlehem. |
| Lee, Walter John, Jr. | Bus., | Westfield, N. J. |
| Lenna, Harry Albert | B.A., | Jamestown, N. Y. |
| Lewis, Harry Walter | Bus., | Bethlehem. |
| Lewis, Robert Beckwith | M.E., | Bethlehem. |
| Light, John Dirks | B.A., | Lebanon. |
| Littell, Isaac William | Mar.E., | Staunton, Va. |

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| Lobo, David | M.E., | Caracas, Venezuela. |
| Loeser, Albert Richard | B.A., | Elizabeth, N. J. |
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| Luria, Israel David | B.A., | Reading. |
| Lynch, Allen Clark | E.M., | Pitman, N. J. |
| MacFadden, Donald Schoonmaker | B.A., | Kingston, N. Y. |
| McCarty, Blain Allen | B.A., | Pen Argyl. |
| McCombs, Charles Edward | Bus., | Bethlehem. |
| McCord, Herbert Weymouth | M.E., | Flushing, N. Y. |
| McGoldrick, Hugh Francis | B.A., | Medford, Mass. |
| McKechnie, Edward | E.M., | Franklin, N. J. |
| McMorris, William Loring, Jr. | E.M., | Portsmouth, Va. |
| Maginniss, Hamilton John | M.E., | Philadelphia. |
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| Manner, Richard Jacob | E.E., | Bethlehem. |
| Martindale, Harry Turner | Bus., | Glen Ridge, N. J. |
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| Matheson, Kenneth Darragh | B.A., | Pittsburgh. |
| Metz, John Henry | E.E., | Scranton. |
| Meurer, Louis George, Jr. | Bus., | Flushing, N. Y. |
| Michelena, Domian German | Mar.E., | Puno, Peru. |
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| Miller, John Howard Payne | E.M., | DuBois. |
| Miller, John Stanley | C.E., | Harrisburg. |
| Miller, Roger Light | C.E., | Lebanon. |
| Miller, William Crichton | Bus., | DuBois. |
| Mills, Lucius Michols | Bus., | Newton, Conn. |
| Moclair, Joseph John | Bus., | New York, N. Y. |
| Molitor, Arthur Albert | Ch.E., | Swedesboro, N. J. |
| Nagel, Charles Herbert | B.A., | Brooklyn, N. Y. |
| Nedewiski, Anthony Theodore | Chem. | Scranton. |
| Ness, Henry Clarence | C.E., | York. |
| Nevins, Samuel Lyle | C.E., | Hokendauqua. |

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| Nicholas, Joseph Anthony | E.E., | Dunmore. |
| Nicholas, John Hall | M.E., | Brooklyn, N. Y. |
| Nicholson, Charles Houston | Ch.E., | Bethlehem. |
| Nitchie, Spencer Holmes | C.E., | Cranford, N. J. |
| Norbeck, Earl Frank | M.E., | LaCrosse, Wis. |
| Nutting, Harry Otis | E.M., | Lebanon. |
| Olton, Frederick Hastings | Bus., | Cranford, N. J. |
| Ortlip, William Marshall | Ch.E., | Oxford. |
| Oswald, Edwin Miller | Ch.E., | Arlington, N. J. |
| Oswald, John Randolph | M.E., | Catasauqua. |
| Ott, Frank Wesley | Bus., | Bangor. |
| Owens, Sidney James | B.A., | Apollo. |
| Palau, Conrado | Bus., | New York, N. Y. |
| Palm, William Flickinger | Ch.E., | Bethlehem. |
| Parker, Albert Marcus | M.E., | East Orange, N. J. |
| Parsons, Ira Manning | Bus., | Baltimore, Md. |
| Passant, John Edward | M.E., | Chestnut Hill. |
| Pennington, Carl Shaw | C.E., | Trenton, N. J. |
| Perry, Milford Eugene | E.E., | Hartford, Conn. |
| Phillips, Arthur Harrison | E.E., | Reading. |
| Pickel, Harry Adams, Jr. | M.E., | Lansford. |
| Picking, Jay Wilfred | E.E., | Somerset. |
| Poor, Benjamin Wood | E.E., | Glendale, O. |
| Posey, James Byron | C.E., | Bethlehem. |
| Racz, James Charles, Jr. | Bus., | New Brunswick, N. J. |
| Raine, Robert Newton | M.E., | Scranton. |
| Raleigh, Walter Allen, Jr. | Bus., | Baltimore, Md. |
| Rambler, Ralph Cassell | E.E., | West Hanover. |
| Raught, Roland Davis Jones | M.E., | Lewes, Del. |
| Reed, James Joseph | B.A., | Bethlehem. |
| Reed, Thomas Henry | B.A., | Genoa, Italy. |
| Richards, Robert Wardick | E.M., | Pittsburgh. |
| Ridsdale, John Gordon | Ch.E., | Washington, D. C. |
| Rights, Herbert Theodore | E.E., | Bethlehem. |
| Riskin, Milton Bernard | B.A., | Bethlehem. |
| Roberts, Charles Bayard | C.E., | Mount Vernon, N. Y. |
| Roberts, Charles Wilson | Bus., | Philadelphia. |
| Robinson, Kenneth Irvin | M.E., | Millville, N. J. |

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| Robinson, Thomas | Bus., | Hackensack, N. J. |
| Roderick, Rees Morgan | Ch.E., | Wilkes-Barre. |
| Roe, James Baynard | B.A., | Sudlersville, Md. |
| Roeder, Elton Mohr | E.E., | Bethlehem. |
| Ross, Donald Thornton | B.A., | Wilkes-Barre. |
| Rubsamen, Herbert Schultz | B.A., | Murray Hill, N. J. |
| Russell, Hiram Brooks | C.E., | Williamsport. |
| Sample, Edgar Hoopes | E.E., | Bethlehem. |
| Sampson, Henry Hazen | M.E., | Westfield, N. J. |
| Sandwick, Charles Martin | B.A., | Elmira Heights, N. Y. |
| Sarmiento, Antonio, Jr. | E.E., | Santurce, P. R. |
| Sarson, Harry Fowler | Bus., | East Orange, N. J. |
| Sasse, Louis Henry | E.E., | New York, N. Y. |
| Saxton, Robert Hibberd | Bus., | Chicago, Ill. |
| Schaffer, John Abraham | Bus., | Allentown. |
| Schaeffer, Max William | E.M., | Womelsdorf. |
| Schaub, Carl Martin | Met., | Freeland. |
| Schaub, Earl Hartman | B.A., | Freeland. |
| Schmalz, Frederick Willard | Bus., | Weehawken. |
| Schmertz, Edward Augustus | E.E., | Atlantic City, N. J. |
| Schmutz, George Henry | M.E., | West Hoboken, N. J. |
| Schoenly, Jackson Heiss | C.E., | Bethlehem. |
| Scholl, Roy Franklin | B.A., | Bethlehem. |
| Schwab, Edward Franklin | B.A., | Bath. |
| Scott, Thomas Earl John | E.E., | Ambler. |
| Seaman, Stephen Francis | B.A., | Bethlehem. |
| Shaner, William McBride | B.A., | Philadelphia. |
| Shartle, John Adam | M.E., | Franklin, O. |
| Shonk, Albert Davenport | Bus., | Kingston. |
| Shultz, Samuel Thompson | Ch.E., | Danville. |
| Shurtleff, John Edgar | Bus., | Clarks Summit. |
| Sidebotham, Horace Williams | Bus., | Philadelphia. |
| Sigafoos, Andrew Wilson | E.E., | Phillipsburg, N. J. |
| Sinwell, Paul William | E.M., | Bethlehem. |
| Sitler, Charles Everett | M.E., | Mauch Chunk. |
| Smeltzer, Norman Harold | Bus., | Bellefonte. |
| Smith, Cedric Leland | B.A., | Wakefield, Mass. |
| Smith, Edmund Hartley | Bus., | New York, N. Y. |
| Snyder, Charles Samuel | E.E., | Northampton. |

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| Sosa, Ricardo | E.E., | Salta, Argentina, S. A. |
| Spalding, George | M.E., | Florence, Ala. |
| Spatz, Norman Samuel | E.E., | Bernville. |
| Spillman, Emil Henry | Met., | Catasauqua. |
| Sponsler, John Bernard | E.E., | Williamsport. |
| Staller, Alfred William | E.E., | Pottsville. |
| Staples, William Frank | Bus., | Bridgeport, Conn. |
| Stevens, Kermit Francis | Bus., | Kensington, Conn. |
| Stevens, Samuel Carlton | M.E., | South River, N. J. |
| Stillman, Charles Allen | Bus., | Akron, O. |
| Stoddard, Elwood | E.E., | Bangor. |
| Strohl, Paul Gogel | C.E., | Cementon. |
| Sullivan, Walter Francis | B.A., | Bethlehem. |
| Swindells, William | C.E., | Portland, Ore. |
| Swinton, Neil Williams | B.A., | Marquette, Mich. |
| Symons, Ralph Hampton | C.E., | Johnstown. |
| Terry, Frederick Barnett | Bus., | Waynesboro. |
| Thum, Kurt William | B.A., | Newark, N. J. |
| Tijerino, Caesar Dardnaius | E.E., | New York, N. Y. |
| Timen, Lawrence Sigmund | B.A., | New York, N. Y. |
| Toadvine, George Henry, Jr. | B.A., | Williamsport. |
| Trumbull, Albert Henson | M.E., | New York, N. Y. |
| Tyler, Nathan Irving | Ch.E., | Midland Park, N. J. |
| Uebelhart, Donald Nichlous | Met., | Canton, O. |
| Ulmer, Louis Norman | C.E., | Pottsville. |
| Ungerleider, Abraham | M.E., | Phillipsburg, N. J. |
| VanBilliard, Mitchell Walter | B.A., | Bethlehem. |
| VanHorne, Roger Harold | Ch.E., | Germantown. |
| Voegtly, John | M.E., | Pittsburgh. |
| Waesche, Charles Stewart | Bus., | Baltimore, Md. |
| Walborn, Charles Faust | C.E., | Wilkes-Barre. |
| Walck, Willard Raymond | C.E., | Lehighton. |
| Walker, Robert Woods | Ch.E., | Little Rock, Ark. |
| Wall, Thomas Carlton | Bus., | Buffalo, N. Y. |
| Walter, Carl Emil | C.E., | Baltimore, Md. |
| Warner, Lyman Darling | E.E., | Bryn Mawr. |
| Weaver, Paul Lawrence | Mar.E., | Dryden, N. Y. |
| Webster, Joseph Field | Mar.E., | Greenville. |
| Weinroth, Leon | Bus., | Philadelphia. |

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| Wenner, Roy Bruce, Jr. | C.E., | Philadelphia. |
| Werntz, Donald Burleigh | M.E., | Coatesville. |
| Wertman, Paul Samuel | Met., | Palmerton. |
| Weston, Thomas Carl | M.E., | Philadelphia. |
| Weynberg, Bernhard Louis | B.A., | Brooklyn, N. Y. |
| Wickes, Robert Boal | B.A., | Bethlehem. |
| Wilhelm, Frederick Harlan | Bus., | Bethlehem. |
| Wilkinson, Charles Stewart | B.A., | Ben Avon. |
| Willis, Charles Ethelbert, Jr. | Met., | Richmond, Va. |
| Wilmurt, William Foster | Mar.E., | New Rochelle, N. Y. |
| Wilson, William VanZandt, Jr. | Bus., | Glen Ridge, N. J. |
| Wolford, Joseph Glenn | B.A., | Tarentum. |
| Wood, Gar Stephens | B.A., | Collegeville. |
| Wood, Thomas James | Met., | Palmerton. |
| Woolley, John George Patrick | C.E., | Jenkintown. |
| Wright, Kenneth Arden | C.E., | Williamsport. |
| Wright, Thomas Joseph | E.E., | Bethlehem. |
| Yeager, James Roland | Bus., | Reading. |
| Zimmerman, Erick Karl | Ch.E., | Passaic, N. J. |

## SPECIAL STUDENTS

| *Name* | *Curriculum* | *Residence* |
|---|---|---|
| Bitter, Felix Augustus | B.A., | Newark, N. J. |
| Dyche, James Albert | Bus., | Jowaco, N. J. |
| Fernandez, Carl Alberto | E.M., | Buenos Aires, Arg. |
| Frantz, Russell Herling | E.E., | Catasauqua. |
| Grossman, Walter | B.A., | Philadelphia. |
| Huaman, Filberto | M.E., | Lima, Peru. |
| Kanaly, Morris Eugene | Chem., | Belmont, Mass. |
| Lopez, Jose Luis | Bus., | Medellin, Co'bia, S. A. |
| Miller, Harry Bachman | Bus., | Bethlehem. |
| Patton, Edward Thomas | M.E., | Philadelphia. |
| Smith, Charles Adelbert | Met., | Columbus, O. |

## STUDENTS IN THE EVENING SCHOOL OF BUSINESS ADMINISTRATION

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| Amrhein, Irving S. | Bethlehem. |
| Bader, Harry W. | Bethlehem. |
| Bechtel, Lester A. | Allentown. |
| Birk, Robert Matthiss | Bethlehem. |
| Bishop, George William | Bethlehem. |
| Blyth, William | Bethlehem. |
| Bottenfield, F. M. D. | Allentown. |
| Bowman, Donald | Bethlehem. |
| Boyer, Willard A. S. | Bethlehem. |
| Cleveland, Howell Brooks | Bethlehem. |
| Coffin, Stanley N. | Bethlehem. |
| Constable, Albert J. | Bethlehem. |
| Cortright, R. M. | Northampton. |
| Dent, Vyoyan A. | Allentown. |
| Ditterline, Roy E. | Bethlehem. |
| Dolan, Raymond | Bethlehem. |
| Donnelly, James Russell | Bethlehem. |
| Dorney, Edwin H. | Allentown. |
| Dudman, Charles William | Bethlehem. |
| Dwyer, Joseph | Bethlehem. |
| Eberhart, Issac K. | Bethlehem. |
| Enberg, Henry Winfield | Bethlehem. |
| Ford, Terrance J. | Bethlehem. |
| Fowler, John Francis, Jr. | Bethlehem. |
| Girard, Philip Joseph | Bethlehem. |
| Grube, Wallace | Bethlehem. |
| Hain, Robert W. | Allentown. |
| Handwerk, Russell F. | Bethlehem. |
| Harden, Robert D. | Allentown. |
| Herrera, A. Felipe | Bethlehem. |
| Hershey, Justus V. | Allentown. |
| Herstine, Aug. E. | Bethlehem. |
| Hottle, D. J. | Bethlehem. |
| Hushen, John C. | Hellertown. |
| Johnson, G. R. | Bethlehem. |

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| Kellar, Luther A. | Allentown. |
| Kern, Clarence T. | Allentown. |
| Kilpatrick, Lawrence A. | Bethlehem. |
| Kinard, Edgar Carylye | Bangor. |
| Knittle, James E. | Allentown. |
| Koenig, William | Bethlehem. |
| Koons, John L. | Bethlehem. |
| Kunkel, Luther G. N. | Allentown. |
| Lambert, Ambrose | Bethlehem. |
| Lear, Philip S. | Bethlehem. |
| Lehr, C. Ellis | Bethlehem. |
| Lucente, Peter Arthur | Bethlehem. |
| Mack, Clarence C. | Bethlehem. |
| Mackey, C. Paul | Northampton. |
| McLay, Thomas Atkinson | Bethlehem. |
| Male, Rex | Bethlehem. |
| Marsteller F. K. | Bethlehem. |
| Miller, Harry Isaac | Bethlehem. |
| Morgan, John P. | Bethlehem. |
| Newman, Charles B. | Phillipsburg, N. J. |
| Neumann, John | Hellertown. |
| Neumann, Julius, Jr. | Hellertown. |
| Nolan, Frank J. | Bethlehem. |
| Nowland, Harold R. | Allentown. |
| Otrosina, John | Bethlehem. |
| Refowich, Harold Girard | Bethlehem. |
| Reese, Benjamin Harvey | Bethlehem. |
| Rees, William Henry | Bethlehem. |
| Reese, Michael | Bethlehem. |
| Reiff, Harry N. | Allentown. |
| Repasch, Michael P. | Bethlehem. |
| Royal, George Boyd, Jr. | Bethlehem. |
| Ruthhart, Walter C. | Bethlehem. |
| Sames, Charles Samuel | Bethlehem. |
| Saxton, Francis William | Bethlehem. |
| Schuler, N. E. I. | Bethlehem. |
| Sherman, Charles Leonard | Bethlehem. |
| Siegfried, Charles James | Bethlehem. |
| Siegfried, Clyde Joseph | Bethlehem. |

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|---|---|
| Sigal, P. Arthur | Bethlehem. |
| Snyder, Graydon U. | Bethlehem. |
| Snyder, Robert N. | Bethlehem. |
| Spahr, Charles, Jr. | Bethlehem. |
| Tagland, Joseph J. | Bethlehem. |
| Tagland, Leo A. | Bethlehem. |
| Tash, Clarence Andrew | Bethlehem. |
| Terrance, J. Ford | Bethlehem. |
| Turner, James W. | Bethlehem. |
| Vaughn, Albert Clinton | Fullerton. |
| Vollmer, Chester | Easton. |
| Walp, Charles Harold | Allentown. |
| Walters, David H. | Bethlehem. |
| Weikel, Charles H. Harrison | Bethlehem. |
| Weil, Hampton L. | Bethlehem. |
| Wilde, Ralph Edgar | Bethlehem. |
| Willard, Claude | Bethlehem. |
| Witemeyer, Hugh M. | Bethlehem. |
| Yavorski, John J. | Easton. |

## STUDENTS IN EXTENSION COURSES

| Name | Address |
|---|---|
| Adams, Miriam Eliza | Nazareth |
| Allen, Dorothy | Bethlehem |
| Amrhein, Virginia | Bethlehem |
| Angela, M. Rita (Sister) | Bethlehem |
| Baas, Florence E. | Bethlehem |
| Bahnsen, Conrad | Nazareth |
| Ballantine, Elizabeth Stuart | Bethlehem |
| Barner, Mayden Emory | Allentown |
| Beary, Joyce Elizabeth | Allentown |
| Beattie, Marjorie | Allentown |
| Benner, Emma Susan | Bethlehem |
| Biechler, Charles S. | Bethlehem |
| Bishop, Louise Antoinette | Bethlehem |
| Brown, Elizabeth Rose | Bethlehem |
| Brown, Josephine | Bethlehem |
| Burrows, Ruth | Bethlehem |
| Charles, Mary (Sister) | Bethlehem |
| Collmar, Rida Norma | Easton |

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|---|---|
| Cooley, Anne J. | Bethlehem |
| Crane, Grace M. | Bethlehem |
| Crow, Emma Elizabeth | Bethlehem |
| Druckenmiller, Myra | Nazareth |
| Dwyer, Mary M. | Bethlehem |
| Eagen, Eleanora M. | Bethlehem |
| Forrest, Martha C. | Bethlehem |
| Hafner, Gertrude | Bethlehem |
| Heberling, Ella L. | Bethlehem |
| Heckman, Miriam Mildred | West Chester, Pa. |
| Heidenreich, Margaret Ruth | Bluefields, Nicaragua |
| Helmich, Dorothy | Chaska, Minn. |
| Hemsath, Annie E. | Bethlehem |
| Henrie, Anna M. | Easton |
| Hildt, Flora L. | Bethlehem |
| Hoere, Helena P. | Bethlehem |
| Hoxie, Harriet Sanford | Bethlehem |
| Kemmerer, Ada S. | Allentown |
| Kern, Sue E. | Nazareth |
| King, Florence | Bethlehem |
| Kleckner, Ruth E. | Bethlehem |
| Kresge, Harriet Anne | Bethlehem |
| Kunsman, Mamie E. | Bethlehem |
| Laubach, Steward L. | Bethlehem |
| Leith, Elizabeth | Hellertown |
| Leonard, Margaret | Bethlehem |
| Luckenbach, Martha | Bethlehem |
| McNamara, John J. | Bethlehem |
| McSparran, Ruth | Bethlehem |
| Mack, Edith | Bethlehem |
| Martin, Lydia | Macungie |
| Meade, Lillian S. | Easton |
| Miller, Edith M. | Bethlehem |
| Miller, Georgene | Bethlehem |
| Neumeyer, Mae E. | Bethlehem |
| Nolf, Laura A. | Centre Valley |
| Post, Hazel | Bethlehem |
| Reed, Vera Templeton | Easton |
| Ross, Paul S. | Bethlehem |
| Samuels, Elizabeth G. | Bethlehem |

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|---|---|
| Saul, Agnes | Bethlehem |
| Sherman, J. Eloise | Bethlehem |
| Shoemaker, Charlotte R. | Bethlehem |
| Sparks, Octavia | Bethlehem |
| Stark, Elenore | Easton |
| Stephenson, Benjamin | Bethlehem |
| Stocker, Anna Oswald | Nazareth |
| Strouse, Hettie | Bethlehem |
| Thompson, Neve D. | Bethlehem |
| Trauger, Ruth | Bethlehem |
| Vaughn, Amy | Bethlehem |
| Waldman, Harry N. | Catasauqua |
| Weil, Emma C. | Bethlehem |
| Weiser, Abby Kathryn | Bethlehem |
| Wray, Katharine L. | Bethlehem |
| Zimmerman, Irma | Bethlehem |

## Summer Session at Lehigh University, 1923

| | |
|---|---|
| Anderson, Paul S. | New York, N. Y. |
| Carroll, Clara | Bethlehem, Pa. |
| Chrisman, Franklin A. | Northampton, Pa. |
| Dwyer, Mary M. | Bethlehem, Pa. |
| Fatzinger, Essie | Bethlehem, Pa. |
| Graham, George T. | Bethlehem, Pa. |
| Hofford, Hilda N. | Allentown, Pa. |
| Huyette, Samuel L. | Philadelphia, Pa. |
| Kunkle, George | Northampton, Pa. |
| Lowright, William S. | Center Valley, Pa. |
| Rohrbach, Katherine | Topton, Pa. |
| Taylor, Robert N. | Hellertown, Pa. |
| Walker, Mabelle S. | Petersburg, Va. |
| Williams, Laurens A. P. | Woodstock, Vt. |

## Summer Session at the Training School of Vineland, N. J., 1923

| | |
|---|---|
| Altstetter, Mrs. M. L. | Windermere, Fla. |
| Anderson, Miss Nettie | Soldiers Grove, Wis |
| Bates, Mrs. Mildred F. | Rochester, N. Y. |
| Connor, Miss Anna | Scranton, Pa. |
| Connor, Miss A. Elizabeth | Washington, D. C. |
| Eyler, Miss Helen I. | Baltimore, Md. |
| Everts, Miss Bertha | Vineland, N. J. |
| Fergusen, Mrs. Jessie B. | New Bedford, Mass. |
| Fishburne, Miss Mary | Columbia, S. C. |
| Galbraith, Miss Ruth | Yakima, Wash. |
| Hines, Miss Thelma E. | Wilmington, Del. |
| Helten, Mrs. Gladys R. | Rochester, N. Y. |
| Helmes, Miss Esther L. | Manchester, Conn. |
| Ives, Miss Sadie B. | Chicago, Ill. |
| Jewett, Miss Elizabeth E. | Williamsport, Pa. |
| Kenniston, Mrs. B. | Jacksonville, Fla. |
| Leiss, Miss Anna | Indianapolis, Ind. |
| Lewin, Miss Lillie | Berkeley, Cal. |
| MacDonald, Miss Martha | Pittsburgh, Pa. |
| Manges, Miss Catherine | York, Pa. |
| Mann, Miss Lena K. | Donora, Pa. |
| Marshall, Miss Eileen Ray | Wellesley, Mass. |
| Neff, Miss Glenna E. | Springfield, Ohio |
| Nevel, Miss Edna R. | Lock Haven, Pa. |
| Noland, Miss Bessie M. | Fairhaven, Mass. |
| Patterson, Miss Hettie I. | Jacksonville, Ill. |
| Quinn, Miss Anna M. | New London, Conn. |
| Randall, Miss Marian E. | Toledo, Ohio |
| Sistare, Miss Grace M. | Waterford, Conn. |
| Speer, Miss Bessie M. | Webster, Pa. |
| Spencer, Miss Mabel I. | Topeka, Kan. |
| Stafford, Miss Mildred D. | Ithaca, N. Y. |
| Theisen, Miss Luella | Syracuse, N. Y. |
| Weeks, Mrs. Kate | Salem, N. J. |
| Welsh, Miss Tressa | Akron, Ohio |

## SUMMARY OF STUDENTS BY CLASSES AND COURSES

| | Seniors | Juniors | Sophomores | Freshmen | Specials | Totals |
|---|---|---|---|---|---|---|
| Arts and Science..... | 34 | 34 | 37 | 78 | 2 | 185 |
| Business Administration | 22 | 31 | 62 | 91 | 3 | 209 |
| Civil Engineering..... | 24 | 18 | 31 | 44 | .. | 117 |
| Mechanical Engineering | 33 | 24 | 40 | 57 | 2 | 156 |
| Metallurgy ..... | 11 | 9 | 4 | 15 | 1 | 40 |
| Mining Engineering ... | 24 | 21 | 19 | 19 | 1 | 84 |
| Electrical Engineering. | 28 | 23 | 52 | 57 | 1 | 161 |
| Chemistry ..... | 5 | 9 | 3 | 3 | 1 | 21 |
| Chemical Engineering.. | 14 | 22 | 20 | 31 | .. | 87 |
| Marine Engineering.... | 7 | 4 | 3 | 6 | .. | 20 |
| Engineering Physics... | .. | 1 | 1 | .. | .. | 2 |
| TOTALS ..... | 202 | 196 | 272 | 401 | 11 | 1082 |

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|---|---|
| Graduate Students ..... | 43 |
| Students in the Evening School of Business Administration | 94 |
| Students in Extension Courses, 1923-1924..... | 74 |
| Extension Students, Summer Term, 1923: | |
| At the University..... | 14 |
| At the Training School of Vineland, N. J..... | 35 |
| TOTAL ..... | 1342 |

## GEOGRAPHICAL SUMMARY OF STUDENTS

| | |
|---|---|
| Alabama | 1 |
| Arkansas | 2 |
| California | 2 |
| Colorado | 1 |
| Connecticut | 17 |
| Delaware | 5 |
| District of Columbia | 25 |
| Florida | 3 |
| Georgia | 1 |
| Illinois | 6 |
| Kentucky | 1 |
| Maryland | 34 |
| Massachusetts | 10 |
| Michigan | 6 |
| Minnesota | 1 |
| Missouri | 1 |
| New Jersey | 214 |
| New York | 119 |
| North Carolina | 1 |
| Ohio | 17 |
| Oregon | 2 |
| Pennsylvania | 569 |
| Rhode Island | 2 |
| South Carolina | 1 |
| Tenessee | 1 |
| Texas | 1 |
| Utah | 1 |
| Vermont | 1 |
| Virginia | 11 |
| West Virginia | 8 |
| Wisconsin | 2 |
| Argentine Republic | 2 |
| China | 2 |
| Colombia | 1 |
| Cuba | 2 |
| Italy | 1 |

| | |
|---|---|
| Mexico | 1 |
| Peru | 2 |
| Philippine Islands | 1 |
| Porto Rico | 1 |
| Venezuela | 3 |
| | 1082 |

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